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Yakataga Beach Placers

By Arthur G. Thompson*

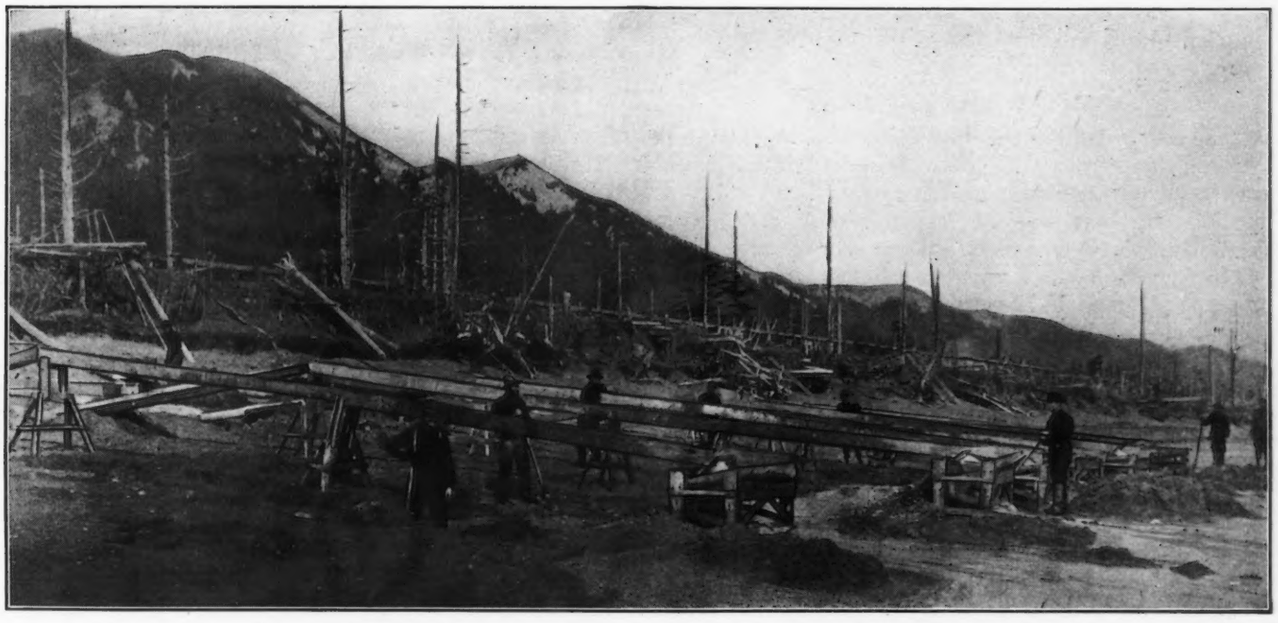
SYNOPSIS—A description of a point on the Alaskan coast where the beach sands contain gold in payable quantity. At Yakataga Beach there are probably the richest of all these concentrations. At times the gold is visible in the concentrated sand.

At a number of places on the coast of central Alaska the sands of the ocean beach contain gold in paying quantities—that is, in quantities sufficient to warrant mining by the simple method of rocker or sluice-box. Among such places may be mentioned Yakataga Beach, Litouya Bay and Kodiak Island.

It is probable that the deposits of gold-bearing sand at Yakataga Beach, designated on the Government maps as Cape Yaktag, are the richest as well as the most extensive. Here beach mining has been carried on continuously, having been the only industry of the place since 1899. From 1903 to the present time there has been a little colony of from 25 to 50 miners actively engaged in working the sands of this beach, although in 1904 reports of rich pay caused an influx of about 250 men. Many of these were not miners and did only enough mining to find out that nuggets of gold were not to be picked out of the sand as potatoes are dug in a field. Having made this discovery, the first boat out carried most of them back to more congenial occupations with the report that Yakataga Beach was a "frost."

Although situated near the 60th parallel, the climatic conditions at Yakataga are such that during mild winters the miners are able to work the beach without hindrance from freezing except during short periods of one or two weeks' duration. The deposit of auriferous sand extends for about 18 miles along the coast, and reaches in places as much as a mile back from the beach. It appears to be a continuous deposit of sea sand and gravel, stratified and more or less classified in places by the action of the waves.

As the level of the seepage water percolating through the sand corresponds closely with the level of mean high tide, the prospecting of the sand deposit below this level has been difficult. Without machinery the miners have not been able to cope with the seepage through the loose sand, and the consequent caving of the walls of shafts and prospect holes. Below the drainage level little is known of the depth of the sand deposits or of the values it may contain. However, from Cape Yaktag, for 8 miles eastward, no bedrock has been found, although the creeks, as well as some of the ditches made by the miners for the purpose of conveying water for sluicing, cut through the sand to a depth of from 16 to 18 ft.



Beach Sluicing Operations at Yakataga, Alaska

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Topographically the features of the sand deposit, which lies between the sea and the base of the mountains to the north, are two parallel ridges of sand following the line of the coast, with a gently sloped depression lying between, forming a lagoon or pond in the rainy season and a marshy meadow during the dry months of midsummer. Another depression of less prominence extends in most places from the most northerly of the ridges to the slope of the mountain.

The first ridge, lying just back of the present sea beach, has an average elevation of 12 ft. above the level of mean high tide, and the second ridge, approximately from 1000 to 1500 ft. back from the sea, has an average elevation of 25 ft. above the same level. The depression between the two ridges, which has an elevation of a few feet above mean high tide, is partly filled with a deposit of clay—the settling from the muddy waters that fill the lagoons during heavy rains.

Both ridges are of the same composition of stratified sand and gravel as the present beach. This is disclosed in numerous places where they have been cut through by streams, as well as by the ditches of the miners. The first ridge from the sea is covered with a growth of the wild rice and redtop grasses indigenous to this section, while the second supports a good stand of spruce and hemlock trees of suitable size for saw timber. Both lie above the present beach and are not affected by the sea, which beats upon the unprotected beach in front. Evidently these ridges are ancient sea beaches, where the waves have washed back and forth and concentrated the ruby sand, the black sand and the gold in the strata to be seen there today.

Workings in the Ridges

The first ridge has been worked to some extent by the miners, and contains the ruby strata and values in gold approximately the same as the present beach. Borings made in the bottom of the lagoon between the first and second ridges show a continuation of the sand deposit under the covering of alluvial sediment, which in some places was found to be four or five feet in thickness. It is probable that the ridges are the result of a gradual elevation of the sea floor for certain periods of time, combined with the erosive action of the waters of streams flowing for some distance along the level coast more or less parallel to the sea, although at the present time the coast line is receding. Earthquake shocks and earth tremors are not infrequent in this section, but are not such as to cause serious damage.

All of the sand contains gold, but it is only the concentrated strata of ruby and black sand which have sufficient value to be profitably worked by the present methods of mining on the beach. These strata occur all through the present and the ancient sea beaches and range from 0.5 to 20 in. in thickness. On the present beach they are the result of storm and tidal action, and come and go with the changing conditions of the beach, which is subjected to a periodic advancing and receding action from causes as yet not well understood. It is possible that a variation of the thrust of the ocean current which flows along this coast from the east toward the west has something to do with it.

The Beach Formation

The present beach, which ranges up to 400 or 500 ft. in width and has a slope of from 10 to 25°, forms a natural concentrating table upon which the waves, driven by the wind and tide, accomplish surprising results.

During violent storms the water rushing back and forth upon the beach becomes loaded with sand, which is swept across the beach many hundreds of times during the continuance of the storm. It is during this backward and forward movement of the sand that the separation of the heavier sands and gold occurs and the strata of ruby sand worked by the miners are built up.

Concentration of Heavy Sands

The onward rush of the wave carrying its burden of sand in suspension is arrested by the vertical bank, or by the steep slope of the beach. The crest of the wave striking against the bank—usually from two to 10 ft. in height—is followed by a second impulse or swell of water; then with the volume of water brought in by the momentum of the wave pressed up against the bank, there ensue a few moments of quiet or "slack" water preceding the outward flow of the wave, when the heavy sand and the gold begin to settle. The outward flow of the water down the slope of the beach gathers momentum until it begins to disturb the sand on the surface of the beach, which is the lower limit of the concentrated layer thus deposited. The lighter sand, of a gray color, still remaining in suspension is carried back to the sea or remains until it meets the onrush of the second wave. This action, continued with more or less uniformity for several hours, or during several succeeding tides, covers the upper part of the beach for a width of 25 to 150 ft. with a sheet of ruby sand several inches in thickness. It extends laterally along the beach as far as the same conditions of the bank, slope, etc., continue.

I have watched this interesting exhibition of one of Nature's milling operations conducted on a scale much larger, and with a force more powerful than any used by man. I have seen each succeeding wave adding its small portion to a mantle of garnet (for the ruby sand is nothing but fine garnet) which covered the beach for miles to a depth of from 18 to 20 in. This concentration occurred in the fall of 1903, and was the best I have seen at Yakataga. Undoubtedly hundreds of thousands of dollars in gold lay upon the surface of the beach within easy reach at this time; but the miners there got only a very small part of it. Succeeding storms mixed it back with the gray sand, carried it out, and in places covered it to a depth of 6 ft. with the poorer sand of the beach. It was paying us $5 per hr. per man for the actual time spent in shoveling, the gold being saved by amalgamation on copper plates placed in a light, portable sluice box. While this saving per hour is not unusually high as mining goes at Yakataga, I have since never seen as large a deposit of "pay dirt" spread so uniformly over the whole beach.

Working the Sands

The concentrated ruby sand is worked in rockers and sluice boxes, being shoveled in by hand. It usually averages from $1 to $50 per cu.yd., depending on the degree of concentration. It contains a very small percentage of black (magnetic) sand, though at times there is sufficient to give it a purplish cast. The gold is bright and clean and averages about $18.50 per oz. The individual particles vary in size somewhat at different places on the beach, from mere specks to pieces as large as a grain of wheat. All of them are much flattened, due,

no doubt, to the constant hammering of the sand and gravel by the waves.

I have seen the concentration of the wave action carried so far that the gold could be plainly seen in the sand lying upon the beach. These extremely rich strata are usually quite thin, due to a partial reconcentration of existing strata of greater thickness. I have known two men working together with one rocker to clean up 28 oz. of amalgam, valued at $5 per oz., from the rocker plates at the end of a day's work on rich "pay."

The source of the gold at Yakataga is supposed to be White River, a short stream emerging from under a glacier and debouching upon the gold-bearing beach at about its middle point. The bars of this river carry gold, and a mining company has installed a hydraulic plant near the head of the river and is engaged in mining there during the summer season. It is probable that the application of modern mining methods with the use of dredgers to handle the vast deposit of auriferous sand at Yakataga would prove profitable.

PILING UP RICH "PAY" PREPARATORY TO ROCKING. THE WHITE PIECES ARE CHUNKS OF GLACIAL ICE THROWN UP BY THE TIDE

Queensland Mineral Production in 1914

Gold production of Queensland in 1914 was 249,468 oz. fine, being 16,267 oz. less than in 1913. Other mineral production was as follows, figures in parentheses being the production for 1913: Silver, 253,964 oz. (604,979); copper, 18,436 tons (23,655); tin, 2085 tons (3197); lead, 724 tons (3603); wolfram, 241 tons (359); bismuth-wolfram, 194 tons (184); manganese, 6 tons (27); molybdenite, 78 tons (66); limestone flux, 119,805 tons (161,165); ironstone flux, 48,090 tons (40,838); fireclay, 5317 tons (8388); coal, 1,053,990 tons (1,037,944). The production of opal was valued at $9700 in 1914 and $14,600 in 1913; of other gems $76,800 in 1914 and $210,399 in 1913. No scheelite was reported. The total estimated value of the production, including gold, in 1914 was $14,545,601, a decrease of $4,228,581 from the previous year.

Use of Liquid Air in Industry

The uses of liquid air were recently described in *Engineering,* Vol. 99, pp. 98 and 155; abstr. *Journ. Soc. Chem. Ind.,* Mar. 31, 1915. The use of liquid air in industry has now reached considerable proportions, and it is stated that there are machines of the Linde and Claude types installed which are capable of producing well over 30,000 gallons of liquid air per hour. The greater part of this liquid air is used for the production of oxygen and nitrogen; neon is obtained as a byproduct and is used for filling tubes for electric lighting.

Liquid air is also used for separating pure hydrogen from "blue" water gas. The only rival to the liquid-air method of producing oxygen is the process of decomposing water by electricity, and this cannot compete in cost unless a market can be found for the hydrogen as well as the oxygen. Oxygen is now very largely used for welding and cutting metals by the oxyacetylene blowpipe, for enriching air for blast furnaces, and for increasing the yield of nitric acid in the Birkeland-Eyde electric and the Haeusser explosion processes. Liquid oxygen mixed with organic substances has been tried as an explosive. Nitrogen is largely used for the manufacture of cyanamide, for the Serpek process of preparing aluminium nitride, and for the Haber process of synthesizing ammonia.

The Mineral Production of Nova Scotia for 1914 amounted to: Coal, 7,005,464 long tons; pig iron, 281,428 short tons; steel ingots, 341,818; limestone, 335,515; gypsum, 283,340; coke, 467,730; gold ore, 13,156 short tons; gold, 3158 ounces.

Miami Copper in 1914

The Miami Copper Co., Miami, Ariz., for 1914 reports that 1,099,208 tons of ore was hoisted and 1,096,633 tons milled, averaging 2.28% copper. From this ore 44,579 tons of concentrates was produced, averaging 39.31% copper. The total copper in concentrates amounted to 35,048,445 lb., of which 33,296,010 lb. was recovered as refined copper. Copper sales for 1914 aggregated 32,879,447 lb. at 14.3488c. per lb. The following tabulation is an analysis of the financial statements of Miami for 1914:

SUMMARY OF TOTAL RECEIPTS

From sale of 32,879,447 lb. of copper at 13.3488c....	$4,389,026
From silver proceeds	38,888
From house rentals	10,293
From gain in power and supply account.....	27,868
From dividends on stock investments.....	57,750
From sale of capital stock.....	6,000
Total receipts	$4,529,826

SUMMARY OF TOTAL EXPENDITURES

Mining and milling.....	$1,835,081	
General mine expense.....	298,019	
Freight on concentrates.....	213,659	
Smelting, refining and freight.....	613,911	
Selling, freight and export insurance....	85,837	
Legal expenses	15,162	
New York office expenses.....	41,775	
Total operating expense reported....	$3,103,446	
Less:		
Depreciation shown by property and development accounts.....	$182,338	
Depreciation written off profit and loss	135,278	
Net depreciation charged off.....	47,060	
Actual expenditure		$3,056,386
Interest paid on loans.....		52,274
Interest paid on bonds.....		1,290
Added to construction account.....		69,023
Bonds redeemed		6,000
Total expenditure for year.....		$3,184,973
Balance available for dividends.....		1,344,853
To balance with total receipts.....		$4,529,826

Dividends amounting to $1,120,375 were paid during the year and $224,478.43 was added to the balance of quick assets. The operating profit for the year, as shown by the profit and loss statement, was $1,366,816, and after charging off depreciation a balance of $1,231,538 was carried to the general balance sheet. The total operating cost of producing copper as reported was 9.2045c. per lb. The following table gives details of costs as shown in the report:

		Per Ton Ore	Per Lb. Ref. Copper
Mining:			
Development		$0.31000	.....
Extraction of ore.....		.87756	.....
Total mining		$1.18756	3.9205c.
Milling:			
Direct crushing	$0.17755		.....
Direct concentrating ...	.17173		.....
Tailing and concentrate handling	.04375		.....
Water for concentrating	.09425		.....
Betterments	.01235		.....
Total milling		.49963	1.6456c.
General expenses		.27176	.8951c.
Total cost of producing concentrates		$1.95895	6.4612c.

Underground development consisted of 22,865 ft. within the Captain orebody. On account of the thickness of the ore it is planned to extract it in two lifts, the upper one consisting of ore above the 270-ft. level, from which point a transfer will be made to the main tramming level through specially prepared raises. Blasting of the pillars between the shrinkage stope rooms in the Northwest orebody was completed in the early part of the year and the drawing of broken ore started. About 60% of the total ore hoisted came from this area. A 60,000-cu.ft. ventilating fan now supplies air to the workings, and the beneficial effect from this fan led to the installation of a second one, of the suction type, on the surface above the Captain orebody.

The mill was operated at full capacity during the first seven months of the year, but production was reduced in the latter part of the year on account of the war. Improvements made in Section 6 proved a success, and plans were made for remodeling the entire plant to treat 4200 tons a day. The change consists principally in finer grinding and additional table treatment on the sand floor of the mill and improved methods of handling and treating the slime products. The increased capacity on the sand floor will be obtained by using double-deck tables, and finer grinding will be accomplished by 8-ft. by 66-in. Hardinge conical pebble mills in the sand-floor tunnels. The product of these mills will be raised by elevators and reclassified for table treatment. The material leaving the sand floor will have the fine sands removed in 8-ft. conical tanks, the overflow of which will pass to six Dorr thickeners 46 ft. in diameter by 10 ft. deep, one to each section, and located outside of the mill building. The thickened pulp will join the reject from the slime tables for further treatment. The mill bins will be raised to 10,000 tons' capacity.

Further prospecting was stopped at the time of the curtailment in production, so no increase in ore reserves is shown except what was opened by current development. Ore reserves are estimated to contain 19,500,000 tons of sulphide ore averaging 2.4% copper; 17,000,000 tons averaging 1.21% copper and 6,000,000 tons of mixed sulphide and oxidized ore averaging about 2% copper. Experiments are under way to determine some way to treat this mixed ore, and it is hoped that within a reasonable time this ore will be available for treatment. According to these figures, there are about 13 years of operations on the high-grade ore alone and about 25 years of life on an average grade of 1.85% ore, if the 17,000,000 tons of 1.21% ore is considered.

America's Opportunity in Argentina

One of the principal mining operators of the Argentine Republic, an Argentino himself, when questioned regarding mining conditions and opportunities in his country, replied as follows:

Argentina is in the same condition now that the United States was in 1805, before the mines were discovered. Then the entire interest of your country was in agriculture and stockraising. Argentina is in about the same condition now. The people are not progressive—they are satisfied to do things the way their forefathers did them, and their only salvation is in the introduction of American capital and brains in the development of mines that up to now are practically untouched. The mineral resources of Argentina are wonderful. I have lived 15 years in the Sierras, and I know what I am talking about. You are going to find the Argentine people opposed to the adoption of novel ideas. The only advancement made here has been by foreign capital and foreign brains and methods. America's opportunity comes now. The richest families here are yet uncultivated and unrefined, a strange fact in view of the opportunities they have had to advance themselves. The fact is they lack the necessary ambition. We must work to bring Americans in here to develop the rich mineral resources that are now lying idle and to set an example of progress for our people to follow. Of course the war is a handicap, but it provides the right time to begin, since you can get more attention and respect now than were the people busy with other things.

Mining Low-Grade Copper Ore by Ray Consolidated

By Alec N. Penny*

SYNOPSIS—Ore mined by shrinkage stoping, with subsequent pillar caving. Main shafts located with reference to centers of gravities of orebodies determined by previous churn drilling. Bonus, contract and leasing systems used in combination regularly as part of mining method. High timbering costs offset by unusual economy in breaking of ore by system employed.

The mines of the Ray Consolidated Copper Co. are situated on the west side of Mineral Creek, at Ray, Pinal County, Ariz. The country is mountainous, rising to a height of 3000 ft. above the creek on the east side, but on the west the rise is rather less abrupt, being about 300 ft. to the mile, steep enough, however, to make transportation difficult.

The ore occurs in two large lenticular bodies which dip gently in a northeasterly direction. Though generally spoken of as two separate orebodies, the ore is really continuous, merely thinning down between the two main lenses and consists essentially of disseminated chalcocite in schist. The orebody is extremely irregular in shape and is covered by a leached capping of the same rock several hundred feet in thickness, and is underlaid by primary rock—i.e., schist mineralized with cuperiferous pyrite below commercial grade. The transition from leached capping to ore is very abrupt and well marked, but the change from ore to primary rock is only moderately so.

Before commencing mining operations, the company systematically blocked out the ore by means of churn-drill holes spaced 200 ft. apart each way. From these holes the tonnage and grade of the ore were accurately determined and the centers of gravity of the two orebodies located. This made it possible to plan the development work to much greater advantage than can usually be done in mining. In locating the main shafts, three points were considered: (1) Surface topography and ground likely to be encountered in sinking; (2) convenience to the railroad; (3) distance to center of gravity of orebodies. Two main vertical shafts were established about a mile apart, each with its independent coarse-crushing plant and ore bins. The two main shafts are used exclusively for hoisting ore, while an inclined shaft at each plant handles waste rock, timber and supplies and is provided with a stairway for the men.

The controlling factor in locating the main haulage levels was the vertical range of the ore. The orebodies at their highest portion are about 150 ft. above the railroad grade along Mineral Creek and extend to a depth of about 500 ft. below it. An adit was driven at each mine at the elevation of the railroad. This level takes care of all the ore above it. Three other main levels will take care of all the ore below the adit. The distance between these levels varies somewhat, depending upon the shape of the orebodies, but the maximum distance between motor levels is 175 ft. Main haulage drifts were laid out on the two upper levels in each mine. These haulageways were planned with two ends in view—to get the shortest possible haul for the ore and to pass under as little mineable ore as possible. The caving system contemplated was expected to cause immense pressure on the drifts under the caved area. For this reason any ore overlying the main haulage drift could not be mined until all other work on the level was finished. In other words, a pillar must be preserved around the main haulage drifts until the level is exhausted.

From the main haulage, parallel drifts are driven on north and south lines, 50 ft. apart, through the orebody.

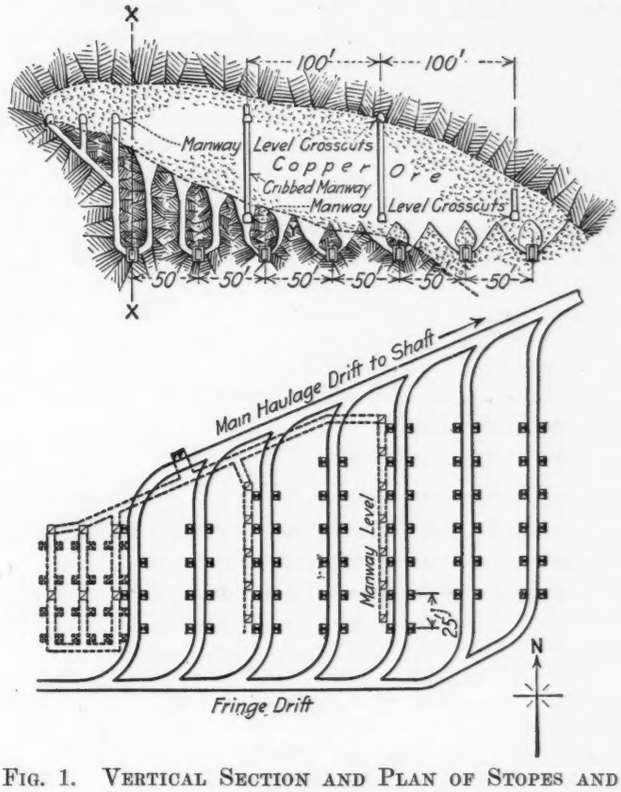

Fig. 1. Vertical Section and Plan of Stopes and Workings

These drifts are connected at the far ends by what is called a fringe drift. This gives access to all drifts from both ends, as may be seen in the plan. When mining operations commence, empty cars are run in from the fringe drift and the loads taken out from the main drift end.

An interesting method was used to lay out the grades of the main levels. Assuming the main shaft to lie to the northeast, the whole level is assumed to be a plane tipped at such an angle that the downgrade to the north is 4 in. in 100 ft., and the downgrade to the east the same. A datum point on the level is established, and from this point it is a simple matter to figure the proper elevation of any other point on the level. This simple system, once in force, requires little extra work on the part of the surveyor and eliminates the common condition underground

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of two drifts on the same nominal level, but not driven with the idea of connection, ultimately connecting at an ugly difference of elevation.

The system of mining in use comprises shrinkage stopes with subsequent pillar caving. There are two variations in the method of extracting the ore. In Fig. 1 is shown a plan and section which illustrate the application of the two systems, which for convenience we will call system A and system B. System A is used to extract the main portions of the orebody. System B is applied to those outlying portions of the orebody which are too thin to warrant the more expensive development of system A.

Mining the Main Orebody

In the figure the portion of the orebody to the right of the line *X-X* is stoped by system A. The plan shows a series of north and south crosscuts spaced on 50-ft. centers, connected at one end by the main haulage drift to the shaft and at the other end by the fringe drift. Chutes are built in these drifts within the orebody, on east and west lines 25 ft. center to center, and from these chutes raises are run up to a height of 25 or 30 ft. above the track level or to the ore. Where ore is encountered within 25 ft., the raises are connected by east and west drifts forming the stope sill level. In the section it will be seen that such a drift going west would encounter waste at *Y*. From this point an inclined raise is run up along the bottom of the ore to connect the remaining chutes. The stope sill development is completed by north and south crosscuts, not shown in the illustration, driven every 100 ft., intersecting the east and west stope-drifts. At a convenient height above the stope sill, a manway level is provided (shown in dash lines in the plan). The manway level consists of north and south crosscuts located vertically above the corresponding north and south crosscuts on the stope sill level.

Stoping is commenced preferably next to the fringe drift. The width of the stope depends on the nature of the ground, which of course is variable. The wider the stope can be carried, the cheaper it can be broken, and the easier it will be subsequently to cave the pillars. A good average width for stopes, spaced on 25-ft. centers, is 15 ft., which leaves a 10-ft. pillar, running east and west, between adjacent stopes.

The first operation preparatory to stoping is to bell the raises. A man with a stoper widens out the chute raises in the form of inverted cones until the top is the full width of the stope and stretches east and west to the neighboring raises, 15 ft. wide north and south and 25 ft. east and west. This work is started near the chute so that nearly all the ground broken in the process can be left in the raise, forming a working floor upon which the machine men can stand when they drill the back of the stope. In each stope sill crosscut, 7 ft. north of the stope center, a manway set is erected. The manway set is merely an elaborated square set which serves as a foundation for, and a means of entrance to, a cribbed manway, which is built upon it as the stope progresses upward. Before blasting the back the first time, the manway set is lagged on the three sides nearest the stope, and it is usual to drive a vertical raise over the manway sets before stoping begins. These raises connect through to the manway level above and provide ventilation in the stopes and also serve as an extra means of entrance and exit. For this purpose ladders are placed in the raises and from the lower wooden ladder a chain ladder is hung into the stope.

Stoping proceeds as usual by drilling and shooting down the back, just enough muck being drawn from the chutes below to leave a convenient working distance above for the men to drill.

While this stope is being mined the next stope is prepared. When stope number two is started it cuts off the sill floor manways to stope number one, but as stope number one approaches the manway level the lower manways cease to be of any importance and may be abandoned. Thus two stopes may be worked simultaneously. The stoping sections are considerably larger than the ideal plan shown and a number of them are operated at once to yield the required tonnage.

Mining is continued in the manner described until a whole section has been stoped out. At this stage 35% of the ore broken in stoping has been drawn out of the chutes. There is left 65% of the broken ore in the stopes and all of the pillars. Assuming the stopes to have been 15 ft. wide, 79% of the ore still remains to be taken out.

Mining the Hand-Tramming Portions

It is obvious that before the pillars can be caved and this ore drawn out, all adjacent ore at a higher level must be extracted, such as that portion shown in Fig. 1 west of the line *X-X*. These smaller portions of the orebody are developed by smaller drifts suitable for hand-tramming. A manway level may often be extended to serve these outlying sections. These levels are provided with a two-compartment timbered raise from the main level, located outside the orebody. One compartment is a ladderway and the other serves for a bucket operated by a small hoist for handling timber and supplies.

The drifts in these sections are spaced on 25-ft. centers. The stopes run at right angles to the drifts, and are also spaced 25-ft. centers, as in system A. In these hand-tramming sections, however, flat raises are run from the chutes connecting midway between the drifts, and the stope is silled right over the drift timbers. Manways are provided in every third or fourth drift. In the second set of timbers from the stope chute, a chute is built for the manway, as shown in Fig. 2, which is to catch the muck broken in the construction of the manway and any ore that may be shot into the manway during stoping. A vertical raise is started just inside the chute and carried up about 10 ft. above the back of the drift. Two stringers are laid, one end resting on the drift sets, the other end in a hitch in the raise (see *E* in Fig. 2), and a manway set is usually built upon them. Although the manway set facilitates drawing the chute later when the pillars are caved, as the posts can be shot out, whereas cribbing would be difficult to break, it is not necessary during stoping, as entrance is from below, and it is usually omitted when the manway is at the end of the stope. The manway is connected with the flat raises and the chutes which have been kept open to this point are allowed to fill with broken ore. The stope is widened out from the chute raises by inclined holes to each side. The manway is cribbed up to within 3 or 4 ft. of the back, and stoping proceeds as in system A. In carrying up the stopes, the ground over the manway is drilled somewhat in advance of the rest of the stope, thus allowing the manway to be cribbed up high enough so that the ground shot down in the stope proper will not run down into the manway chute.

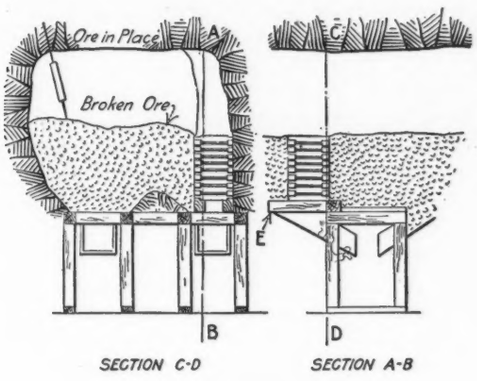
The stoping crew consists of a stope boss, two or three machine men, and if the stope is a large one, two or three

pickmen. In the smaller stopes the machine men bar down before drilling. Wherever possible it is arranged that each shift will leave one manway clear—i.e., not drill that part of the stope. This leaves a safe entrance for the opposite shift, and the pickmen start from this manway to bar down the stope. They are followed by the machine men, who thus have a solid back to drill. All drilling in the stopes is done with the regular stoping drill.

Drawing the Chutes and Pillars

As fast as the small sections are stoped out additional chutes are built in every drift, midway between the stope chutes. When these chutes are completed, drawing officially commences. Wherever the ground is solid, flat raises are started from these pillar chutes exactly as in starting a new stope; but often the ground will already have started to crush and a few holes drilled from the chutes will be sufficient to start the muck running. Whenever a large boulder appears in the chute, a little powder is placed under it, which usually starts the muck again. Where the ground is not so crushed, the flat raises are connected, and the back and sides of all raises are drilled and shot. Drawing then proceeds as in system B.

When all the chutes in a section have been drawn to capping, there remains a pyramid of ore between the drifts. This point has not yet been reached in any of the large motor haulage sections, however. In the hand-tramming sections, if the grade of the ore warrants it, new drifts are driven midway between the old tramming drifts to tap this remaining ore. These drifts, locally known as cone drifts, are driven and timbered on contract. Between the original drifts spaced on 25-ft. centers there is an 18-ft. pillar of ore. As has been shown, the rock drawn from a chute under these conditions leaves it in the form of an inverted cone. The sides of this cone are much steeper than if the ore were drawn from a chute in the bottom of a flat-bottom bin. In drawing a caved orebody, the chutes are never empty, the ore being finally replaced in the chute by waste. The waste exerts a supporting force upon the ore forming the sides of the cone, so that the line of division between ore and waste stands at an angle of about 50 degrees. This can be seen very nicely in opening up the ground adjacent to old chutes, when a distinct



SECTIONS THROUGH STOPE IN HAND TRAMMING WORK

FIG. 2

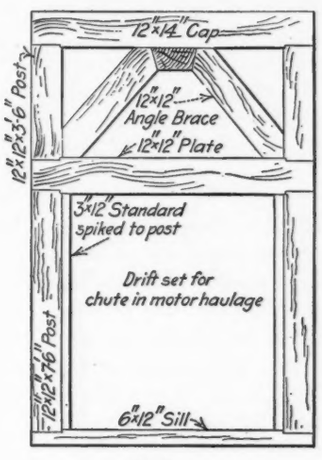
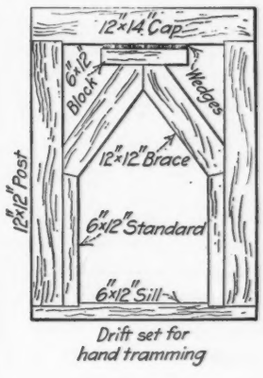


FIG. 3



Drift set for hand tramming

FIG. 4

Details of Stope and Drift Sets

connected as in stoping. If the ground still remains firm, the backs of the raises are drilled and shot. Eventually chutes are built in each set of timber.

As soon as drawing begins, the section is provided with a car checker, who reports the number of cars drawn from each chute. The engineering department keeps track of this work and certain chutes are sealed up when necessary to insure the ore being drawn evenly so that as little capping as possible will be mixed with the ore. A chute is sealed permanently as soon as capping appears in it and the drawing continues from other chutes until the section is empty. When drawing is completed in all the adjacent sections, the main portion of the orebody may be drawn in the same way. The process of caving the pillars is much the same as in the small stoping sections, but the stopes being silled higher and the drifts farther apart, the preparation is rather more elaborate. Chutes are built midway between the stope chutes, and flat inclined raises are driven from these chutes connecting from one drift to another. Then starting about 7 ft. inside the chute, branch raises are driven inclined back over the drift. If the ground remains solid these branch raises are also connected, and the back and sides of all raises are drilled and shot. Drawing then proceeds as in system B.

When all the chutes in a section have been drawn to capping, there remains a pyramid of ore between the drifts. This point has not yet been reached in any of the large motor haulage sections, however. In the hand-tramming sections, if the grade of the ore warrants it, new drifts are driven midway between the old tramming drifts to tap this remaining ore. These drifts, locally known as cone drifts, are driven and timbered on contract. Between the original drifts spaced on 25-ft. centers there is an 18-ft. pillar of ore. As has been shown, the rock drawn from a chute under these conditions leaves it in the form of an inverted cone. The sides of this cone are much steeper than if the ore were drawn from a chute in the bottom of a flat-bottom bin. In drawing a caved orebody, the chutes are never empty, the ore being finally replaced in the chute by waste. The waste exerts a supporting force upon the ore forming the sides of the cone, so that the line of division between ore and waste stands at an angle of about 50 degrees. This can be seen very nicely in opening up the ground adjacent to old chutes, when a distinct dividing line may be seen between the red capping and the gray ore.

On account of this high angle of the cones a large amount of ore is obtained from the cone drifts. Chutes are built in every set of timbers, and when these have been drawn empty, back chutes are put in and the last car of ore that can be obtained is drawn out.

The section is then turned over to leasers, who take out the ore below the level of the chutes and deliver it to the motor cars at so much per ton.

Motor Haulage and Tramming

By far the greater part of the ore is drawn direct from chutes into the five-ton cars of the motor haulage system. Empty cars are generally run into each drift where drawing is in progress, and are loaded by crews of two men each. The motorman and brakeman are occupied continuously taking away the loaded cars and bringing empties back. The loads are generally taken out to the shaft in trains of nine or 12 cars and dumped three at a time in a revolving tipple. On levels where there is a long straightaway haul much longer trains are handled.

In the smaller stoping sections, where hand tramming is used, the trammers work on a bonus system. One-ton cars are used, of the ordinary oblong type with hinged door in front. The length of tram varies considerably with the accessibility of the section to raises from the motor haulage level. In favorably located sections the average tram is not much over 25 ft. and the trammers will take out from 75 to 100 cars a shift, receiving a bonus of 3 or 4c. for each car over 50. In particularly inaccessible sections the tram may be 200 or 300 ft., with a correspondingly decreased production per man.

All drifting and raising is done on contract. The company furnishes all supplies and the contractor pays for all labor. Prices vary widely with the nature of the ground and the disposal of the muck. For motor drifts driven 8x8 ft. in the clear without timber, the price for good breaking ground is $3.50 to $4 per foot. For the smaller drifts, 5x7 ft., the price is from $1.75 to $2.75 per foot. Chute raises for stopes are contracted at 65c. to $1 per foot, the company handling the muck. Higher prices are paid for the longer raises. Stopes have been contracted both on yardage and on footage of holes drilled, but to little or no apparent advantage. Ordinarily the contractor is allowed five sticks of 30% powder for each hole drilled. The powder allowance may be increased at the discretion of the foreman, but this amount is usually sufficient to break the ground. Little wet ground is encountered and double primers are not found necessary.

Timbering

Nearly all drifts in ore will stand without timbering, and are only timbered in preparation for stoping. On the other hand, a good deal of the development in waste requires timbering. For this purpose either 10x10-in. or 12x12-in. timbers are used. The motor drifts are timbered 7 ft. wide and 8 ft. high in the clear, using vertical posts dapped 1 in. into cap and sill. Sills are always used, either 6x10-in. or 6x12-in. Turnouts are designed carefully, using 50- or 60-ft. radius for curves. When turnout timbering calls for caps over 12 ft. long, 12- or 15-in. I-beams are used. The I-beams are fitted with a steel plate at each end flanged down 1 in. all around to fit the top of the post.

Timber sets within the stoping area are specially designed, see Fig. 3, with the intention of converting them later into chute sets. The posts are shorter, 7½ ft., and a pony set 3½ ft. high, subsequently erected upon the cap, makes the total height 12 ft. Girts 12x12 in., beveled on the upper inside corner, fit between the lower caps and support the bottom of the chute. The chute itself is built of 3-in. lagging. All parts are cut to size in the framing shed. In good ground timber sets are spaced alternately 5- and 7½-ft. centers, and chutes are built in the 5-ft. sets. This provides stope chutes every 25 ft. along the drift, and pillar chutes half way between them. Before caving the pillars in any section, the pony sets are reinforced with three-piece angle braces, two 12x12-in. angle pieces with a key block.

The size of these sets is partly determined by the Arizona law, which provides that the trolley wire must be 6½ ft. above the rail. The only convenient arrangement of the trolley wire is at the side of the drift so that it passes under the chutes, which necessitates chutes much higher than is required to clear the cars.

In the hand-tramming sections the timber sets, see Fig. 4, are placed on 5-ft. centers, and are 5 ft. wide and 8 ft. high in the clear. Posts, 12x12 in., are used with 6x12-in. sill and 12x14-in. caps. Angle braces of 12x12 stuff are put in before pillar caving commences. To support the angle braces, 6x12-in. standards are placed against the inside of the posts. These standards are beveled slightly on top so that the angle braces resting upon them hold them in place against the posts. The two angle braces, as first planned, met under the caps, fitting tightly. It was found that when the cap took weight it was forced down upon the angle braces in the middle, so that the braces eventually cut completely through it. To prevent this, the angle braces were made to meet about 7 in. below the cap, and a 6x12-in. block about 2 ft. long was placed between the cap and the angle braces. Wedges were then driven tightly between the cap and the block.

By far the greatest part of the weight comes on the timbers when the chutes are being drawn; at this time the whole mass of broken ground is in slow motion, similar to the flow of a glacier. For repair work, a set may be opened up and the lagging cut out with little danger of the ground running, but all the time there is a slow settling that no timber will withstand. When the pillars in a section have been caved, the chutes are drawn as fast as possible and just enough repair work is done to keep the drift open and safe and the chutes running. As soon as the chutes are drawn down to capping, the drift is abandoned. The cost of timbering and repairing on the levels is a large item of expense, but is offset by the fact that no timbering is required in the stopes, that only a little more than half of the ore is actually blasted in the stopes, and that no shoveling is required at any point.

When a section of the mine has been stoped, cracks usually appear on the surface over the stoped area, or if stoping of itself does not produce cracks, they soon develop when caving commences. As the pillars are drawn the corresponding surface area settles and eventually large holes are formed. While the Arizona climate is generally dry, there are often very heavy rains, especially about January and September. At such times it is important to keep the surface drainage from running into the caved areas, and for this purpose an elaborate system of drainage tunnels and ditches is necessary. Over 5000 ft. of drain tunnels have already been driven, and a large concrete dam will be built in the principal gulch to keep the surface drainage out of the surface caves.

Swedish 1913 Mineral Output

The official report of the Swedish output for 1913 shows the following: Iron ore, 7,475,571 metric tons; bituminous coal, 363,965; zinc ore, 50,752; silver-lead ore, 3222; iron pyrites, 34,319; feldspar, 37,878; quartz, 40,837; manganese ore, 4001; copper ore, 5458 metric tons. Of the iron ore produced, 4,550,390 metric tons carried between 60 and 70% Fe, and 1,820,439 tons more carried between 50 and 60% Fe.

The metal production, excluding iron, was: Copper, 6891 metric tons; zinc, 2114; lead, 1235 metric tons; silver, 1037 kg.; gold, 25 kg. Other products and byproducts of the mineral industry were: Roasted zinc blende, 33,522 metric tons; copper sulphate, 428; alum, 144; ferrous sulphate, 320; graphite, 88; powdered pyrolusite, 73 metric tons.

Recent Rand Metallurgical Practice

By M. Thornton Murray*

SYNOPSIS—A review of the recent changes in metallurgical practice on the Rand. The application of new methods and machinery, many of them of American origin, has produced results tending toward better extraction and lower costs.

The war in South Africa has not directly affected the gold-mining industry on the Rand to a great extent, but it has led to certain restrictions in the activities of metallurgists there insofar as invention, alteration of existing methods of procedure or the trial of new ideas is concerned. Such an intermission is not, however, altogether to be regretted. It has the merit of giving one an opportunity to take a more or less comprehensive view of the metallurgical situation, to examine the new methods of treatment and the modern appliances in use, and to estimate the progress made during the last year or two.

Generally speaking, all experiments which have been made have had greater profit as their goal. Three different routes have been followed for the journey: (1) Increased output, (2) reduced working cost, and (3) higher extraction. Of these the first lies more within the sphere of the miner than of the metallurgist, since (on the Rand, at any rate) the output of the plant is governed by the battery-feed; although the metallurgist must be in a position to handle the maximum output of the battery.

Of the two other considerations it may be said that they are largely interdependent, since it would be easily possible to obtain a high extraction, but at a prohibitive cost. A metallurgical review of progress on the Rand, then, resolves itself into a consideration of recent modifications in treatment methods, remembering that no alteration has been adopted which (so far as the metallurgists can see) has increased working costs beyond the limit of its usefulness. The remark that Rand metallurgy is "merely a matter of economics" is largely true, but seems rather a compliment than the reverse.

Primary Crushing

Both spindle and jaw crushers are used for the preliminary breaking of the ore coming from the sorting belts; but there is a growing feeling in favor of the latter, owing to the frequency of breakdowns in the former type of machine and the time required and labor entailed in clearing and starting up again. The replacement of the liners—a rather frequent operation when the crusher is working on the "banket"—is a tedious and somewhat difficult operation.

The product from these crushers, forming the battery feed, usually averages 4 in. diameter, and a portion of this is now bypassed to the tube mills, to serve as tube-mill pebbles, the ore being hard enough, in most cases, to replace the old flint pebbles, which were not only expensive to buy but simply served to dilute the pulp with barren material.

Stamp Milling

It almost seems, at first sight, as if crushing in the battery had reached the limit of coarseness; although after the comparatively recent sweeping alterations in battery practice one hesitates to prophesy that there will be no further changes. However, coarser crushing would probably involve heavier stamps, and the wear on screens, frequency of breakage of camshafts and stems and comparatively high consumption of metal per ton of ore crushed, even under the present régime, make it difficult to imagine that heavier stamps could be worked satisfactorily without drastic structural alterations. In this connection the reinforced-concrete and steel kingposts which were tried at one mine may have proved satisfactory, but they have not been tried on any of the subsequently erected batteries on the Reef. Nissen individual-mortar stamps have been tried on the Rand and gave good results, but they have not been largely installed there, although on some of the newer propositions in other parts of the Transvaal and Rhodesia they are being used with success. Practically all the stamps installed in the new mills are of 1900-lb. weight, with long heads (up to 4 ft.) and open-front mortars, five heads falling in each box, but one camshaft generally serving 10 stamps. With the exceedingly coarse crushing at present obtaining (some screens have rectangular apertures measuring 3/8 in. by 3/4 in.) no amalgamation is done either in the mortar box or immediately in front of it. All the amalgamation takes place after the ore has passed the tube mill.

Tube Milling

The chief innovation in tube-mill practice has been the substitution, at one or two of the newer plants, of short tubes of greater diameter (6 ft. by 16 ft. 6 in.) for the standard 5-ft. 6-in. by 22-ft. mill. It is argued that the last few feet of the older type have little crushing efficiency, yet increase the power required for driving the mill. The new mills have given good results, requiring, it is claimed, little or no increase in the power. Experiments to discover the best speed and load for tube mills were carried out in 1913, a specially constructed section (full diameter) of a tube being used for the purpose. These experiments are said to have given highly interesting results, and the conclusions drawn from them have led at least one prominent metallurgist to experiment on a working scale.

In some of the more recent plants the returned oversize from the classifiers working on the tube-mill discharge is being dealt with by special tube mills set aside for the purpose instead of being returned, as heretofore, to the primary tube-mill circuit. A greater control, it is claimed, is thus obtained over the duty of the various mills, while these secondary-circuit mills can be adjusted, so far as load, moisture and speed are concerned, so as to deal more successfully with the relatively finer feed which they have to take. The tubes are usually run at from 31 to 34 r.p.m., on a thick, dewatered feed, liners of the Osborn (longitudinal steel rib) type being preferred.

The Hardinge conical mill, which has been lately tried on one of the mines, proved, we understand, remarkably efficient, so that it may figure in future installations. On the other hand, the improvement in crushing was not considered sufficiently great to warrant scrapping the present mills.

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Amalgamation and Classification

No drastic changes have taken place in amalgamation on the Rand, if we rule out the transfer of the plates from the mill to a special building or to the extractor house—a move brought about by the adoption of the coarse-crushing policy. J. R. Dowling's suggestion for increasing the grade of the plates, doing away with the shaking device and considerably thickening the pulp fed to them, has been adopted on several properties, with good results in labor saving and reduced plate area. Other points which have been discussed in this connection have been the absorption of gold by battery plates and the frequency of dressing the plates.

The chief novelties with regard to classification are regulating devices to prevent overflows when, through irregularity of feed, the classifier has to deal with rapidly varying conditions. Dr. Caldecott's cone, with its appurtenances, is successful in this direction, while other float devices have proved fairly satisfactory. Most of the classifiers on the Rand are now of the cone or spitzkasten type, spitzlutten or more complicated apparatus being generally found wanting under the conditions which obtain on the Reef.

Caldecott sand-filter tables are in use on several mines, and are efficient and cheap. Reinforced-concrete collecting tanks have not been used, except at the City Deep, where they were first installed. Whether we are to regard them as an experimental failure or not is a moot point; but the construction of the old-style steel tanks or newer plants would seem to lead to some such conclusion. They are still being used, however, on the City Deep plant.

In the later plants traveling belts have almost everywhere replaced the Kafir and the "coco pan" as a means of transporting sand, while disk distributors for filling the treatment tanks and Blaisdell plow excavators for emptying both collecting and treatment tanks are the rule. Both of these machines practically demand traveling-belt conveyance to work with them. So far as transportation of sand pulp is concerned, the general lack of natural fall in the ground all over the Rand mining area makes it essential to manufacture headroom by frequent pumping. Centrifugal pumps are usually used, though one or two tailings wheels are still working. With centrifugals, upkeep costs are rather high, especially when the pumps are dealing with a modern, coarse battery discharge, which is very hard on the liners.

Modern methods of sand treatment differ little from those in general use several years ago. At some reduction works which are working on an especially pyritic portion of the reef a pyritic concentrate is collected on blanket strakes and treated separately by grinding in small ball mills with mercury and treating the tailings from this operation with cyanide. The black-sand concentrates obtained from the plates, mortar boxes, etc., are often similarly treated. Lead acetate is now added to most of the sand-treatment tanks to counteract the action of soluble sulphides.

Sand Tailings and Their Disposal

Finer grinding and other improvements in treatment have effected a considerable reduction in the value of the sand tailings going to the dump. A few years ago a tailings value of from 50c. to 75c. a ton was common, as against 28c. to 35c. a ton, which is usual today.

Many of the older mines have considerable difficulty in finding enough dumping ground for their residues. This lack of space means that the dumps have often to be made much higher than would otherwise be the case, with consequent increases in the cost of hauling the tailings. Lack of space for redumping is also one of the chief causes militating against the success of schemes for the re-treatment of the old sand-residue dumps, many of which have a gold value sufficiently tempting to have lured speculators, usually to their undoing.

The blowing of dust from the tailings dumps has been given some attention lately, with the result that various measures, from the treatment of the surface of the dump with molasses or calcium chloride solution, to divert waste rock to the sand dumps, have been proposed, and are at present being tried out on several of the mines. Sand-filling is becoming increasingly important, though, and it is probable that the day is not far distant when most of the tailings will find their way back to the depths from which they came.

Slimes Treatment

The Butters filter was introduced a few years ago on the Crown Mines, and the experiment was so successful that a number of other plants have been put in. The marked success of the device on the Rand is probably partly due to the fact that it is capable of treating not only true slimes but slimes mixed with a large proportion of fine sand; and fine crushing of the banket (which contains comparatively small proportions of the ingredients of a true slime) gives rise to exactly such a mixture. In conjunction with Brown, or Pachuca, tanks using air-agitation the Butters filter has given excellent results, low residues and cheap operation being its chief advantages.

It may be noted in this connection that while the "all-sliming" proposition is not looked upon with any particular favor on the Rand, the proportion of sands to slimes (the terms have almost lost their original significance) produced and treated has gradually altered. One mine, at least, is treating as slimes over 50% of the ore which it crushes. Metallurgists on the Rand are often accused of conservatism; but since there have been very few reactions in favor of older processes in the history of the fields, a certain amount of conservatism seems to have been justified. While certain other mining localities which took up the all-sliming idea with enthusiasm are already exhibiting a tendency to return to the older methods of treatment, Rand metallurgists are apparently feeling their way slowly to a modified sliming system which will give them the best results, both as regards extraction and cost, under the peculiar conditions with which they have to contend.

Perhaps contributory causes to this attitude may be found in the large capital already sunk in sands-treatment tanks and in the fate which overtook the Benoni Consolidated plant. In any case, however, it is doubtful whether, with a hard, tough ore like the Rand banket, with its low gold value, the high cost of skilled labor and the comparatively high cost of water, all-sliming would be the most economical method of extracting the gold from Rand ore.

Precipitation

Precipitation has long been regarded as the weak spot in the cyanide process for gold ores, and as the clean-up of the zinc boxes is a long and laborious process, accom-

panied by danger of gold loss, this view is easily understood. The old zinc-shaving method, with the modifications of a lead-acetate dip for the zinc in the weak solution boxes, a cyanide drip at the head of the boxes and a careful adjustment of the alkalinity (0.006% to 0.008% NaOH is usual), still gives good results, and metallurgists seem unwilling to discard it in spite of its obvious disadvantages.

The zinc-dust processes of Merrill and others have been tried, and are giving satisfaction on one mine, at least, on the Rand; but considerable experimental work was necessary before the process was successful. The chief difficulty appeared to lie in the low gold value and cyanide strength of the weak (slimes) solutions and the difficulty of keeping these in contact with the zinc dust long enough for the precipitation to attain completion.

A new electrical process, which is without the chief drawbacks of the Siemens-Halske process—clumsiness and complexity—is at present under trial at one property. The laboratory tests were claimed to show astonishingly high and rapid extraction of the gold from solution, and preliminary tests were also favorably commented upon. It remains to be seen whether the process will be a success on the full working scale.

Smelting and Assaying

The Taverner pan furnace and cupellation furnace have been installed at practically all the new mines, replacing the old pot-smelting in Cornish coke-fired furnaces. Both these furnaces are coal-fired reverberatories, and the high price and poor quality of the local coke were probably responsible for the introduction of the process, although other considerations, such as economy of labor and time, undoubtedly had their part in the decision.

Routine assaying of mine and surface samples by pot-fusion is now carried out in flat-bedded reverberatory furnaces, using an assay pot of the "Battersea Juleff" form. The pots are more quickly and surely handled in this type of furnace; but the chief reason for the change lies again in the high price of coke and the comparative cheapness of coal.

Grading analyses were formerly performed in the assay office, but they have become such an important part of the metallurgical work that a special room is set aside for them, a proceeding which has the additional advantage of keeping the dust away from the assay office. Standard I. M. screens are usually used, and several types of grading machines (Stadtler's, Blundun's, etc.) find favor.

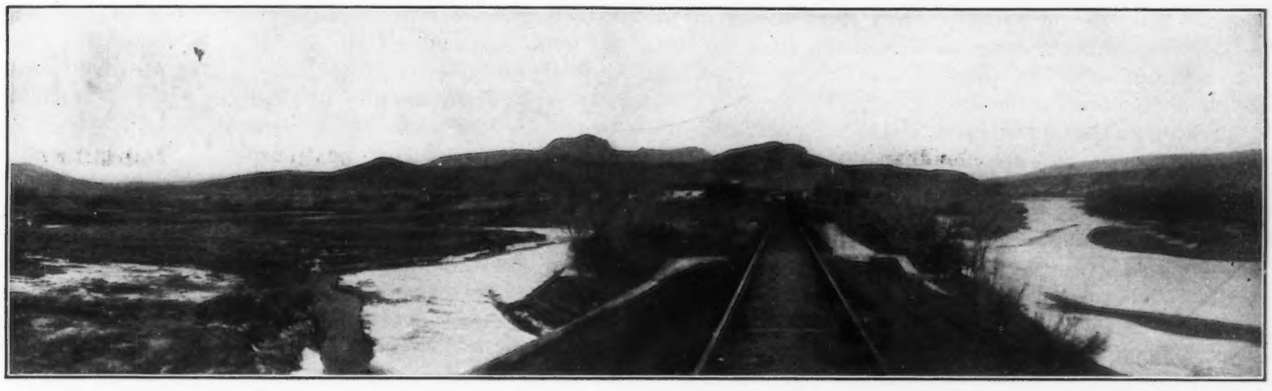
The introduction of electrical machinery all over the surface plant of the modern Rand mine has probably done more toward bringing down working costs than anything else. As the work becomes more and more mechanical, fewer and fewer skilled white workers are required, and the Kafir is becoming less essential to the reduction works, as he has become below ground.

Careful design of plant, the introduction of devices such as the Butters filter, Blaisdell excavator, traveling belts, etc., and the centralization of control have also been responsible for much improvement. Working costs on the surface a few years ago were thought good if they were below $2 a ton; they are now nearer to $1 and there is every probability that they will go even lower.

Bituminous Shales of Colorado

By G. R. DeBeque

While the recovery of oil from bituminous shale (or oil shale) has been an industry of considerable importance in Scotland for the last 50 yr. and in France since 1830, in this country it remains as an undeveloped industry worthy of investigation. The existence of highly bituminous shale in northwestern Colorado and northeastern Utah has been known for several years, but no particular attention had been paid to these formations until the summer of 1913, when an examination of the oil-shale deposits of that region was made by the United States Geological Survey under the supervision of E. G. Woodruff and D. T. Day. The results of this investigation are interestingly described by these gentlemen in *Bulletin 581A*, to which I am indebted for much of the information contained in this article. It is well, however, to explain that I am intimately familiar with the deposits.



View toward Town of DeBeque, Colo., Showing the Bituminous Shales in Background

The tests made during the examination, while not of a character to demonstrate the entire feasibility of utilizing the shale in the production of petroleum, show that the material compares favorably with the Scotch and French oil shales and indicate the existence of a large reserve of oil that will eventually be utilized. The shale area referred to extends westward from Rifle, Colo., to a point near Colton, Utah, a distance of 125 miles. Between these limits the Book Cliffs and the Roan Cliffs rise 1000 to 3000 ft. above an uneven lowland on the south to the plateaus on the north. The bituminous shales underlie the plateaus and outcrop along their southern edges. In Colorado the oil-shale area includes probably 20 townships; in Utah the area may be greater, although

most of the shale is too thin and too deeply covered by other formations to make it of economic importance.

The examination in Colorado was made in the territory contiguous to the town of DeBeque, which is on the Denver & Rio Grande R.R., in the south-central edge of the oil-shale zone. In this territory the shale beds are exposed along a range of hills that rise to the north above the river valley. The entire Colorado area is probably encircled by a belt of outcropping shale between the levels of the lowlands and the plateaus. This condition should greatly enhance the mining possibilities, as the beds could be developed through a system of adits. The shale beds of Scotland and France occur in such conditions that they can be worked only through pits and shafts, some of which are 600 ft. deep.

The Colorado bituminous shale occurs in the Green River formation, of Tertiary age, and is found in lenticular beds from a fraction of an inch to 80 ft. in thickness. At some places the beds are thick and fairly uniform in bitumen content, while at others they split into many thin members, some rich in bitumen and others containing only moderate quantities. The shale does not split or break easily but separates readily from the associated strata. This should prove an important factor in the development of the proposed new industry, since the bitumen-bearing shale can thus be readily freed from the poorer or worthless materials.

In Scotland the oil shale is mined by the pillar-and-stall method when the beds are more than 4 ft. thick, the pillars being left large enough to hold until the second working. Beds under 4 ft. in thickness are worked by the longwall system. The shale is blasted with gunpowder and then passed over a 1-in. grizzly, the undersize being left in the mines. The oversize shale is hoisted and passed through a toothed breaker, in which it is reduced to flat pieces about 6 in. square, as much as 600 tons being handled per day by a single crusher. From the crusher the shale is charged into retorts that are heated with gas made from dross coal in gas producers.

Prospecting for oil in the DeBeque district has proved that a large supply of natural gas exists at no great depth in that territory. Consequently, the fuel question connected with the development of the oil-shale industry may be easily solved.

The Scotch oil-shale area has an extreme length of 24 miles. The Colorado area is at least 50 miles long and 20 miles wide. The beds of Scotland are from 2½ to 16 ft. thick; those in France have an average thickness of about 4½ ft. The Colorado beds are known to be as much as 80 ft. thick in some places along the outcrops. The richer shales in the Scotch fields produce from 30 to 40 gal. of oil and from 25 to 35 lb. of ammonium sulphate per ton of shale, while about 18 gal. of oil and from 60 to 70 lb. ammonium sulphate are recovered from a ton of the poorer grades. French shales produce from 70 to 80 liters (18½ to 21 gal.) of oil and from 5 to 7 kg. (11 to 15½ lb.) of ammonium sulphate per metric ton (2204 lb.) of shale treated. The field tests made by the U. S. Geological Survey experts on the Colorado shales gave returns in bitumen content ranging from 10.4 to 61.2 gal., with an average of 30 gal. of oil per ton of shale. One test, made on shale from a bed less than 3 ft. thick, gave a return of 68 gal. of oil and 22½ lb. of ammonium sulphate per ton. From these results it seems probable that the Colorado shale, at the lowest estimate, should equal in value the Scotch and French shales from which petroleum has been manufactured for so many years.

The proper development of this prospective industry in Colorado must depend upon research, which should be conducted by scientific men for the purpose of ascertaining the most economic methods of mining and distillation. It is hoped that technologists will become interested in this question and will prove whether these great beds of shale can be turned to commercial importance under present conditions.

German Chemical Industry and the War

SPECIAL CORRESPONDENCE

Geheimrath Professor Dr. Otto Witt, in *Chemiker Zeitung,* after pointing out that the war has, generally speaking, seriously curtailed the output of chemical products, owing mainly to the absence at the front of experts who cannot be replaced and the embargo on exports, states that the manufacture of sulphuric acid in Germany is wholly based on the Spanish and Portuguese supply of pyrites, of which there is certainly a very large stock still in hand. As this must eventually come to an end, it will have to be replaced by the cupriferous Norwegian pyrites (copper content about 1.50%). There are also some German pyrites available, and in case of necessity the Hungarian and Steyer pyrites at a heavy cost in transport. Finally, there is the Sicilian sulphur, the freight on which would be only half that of pyrites. In Hamburg there are probably large stocks of Louisiana sulphur.

As regards the question of nitric-acid combinations for explosives, it is pointed out that the import of Chilean nitrate, hitherto mostly used for manurial purposes, has been stopped, though there must be a considerable stock of the latter now available for nitric acid, the farmers being confined to the use of synthetic ammoniates. Synthetic nitrates might also take the place of Chilean nitrate as a raw material if their production can be increased sufficiently to cover consumption. Thanks to the practically inexhaustible reserves at Stassfurt, Germany is particularly favorably situated as regards the salt, soda and potash industries, and she really inflicts great injury on her enemies by withholding the potash salts, which are so valuable as a manure. In France there are those who now have their eyes on the recently discovered Alsatian limestone deposits, which only occur on the German side of the frontier. Geheimrath Witt cannot understand why, at the beginning of the war, people feared for a salt famine, when it is borne in mind that Germany is the richest salt country in the world. Certainly the price has risen considerably, and often in the retail shops one may not get more than 1 kg. But this trouble, he thinks, has more to do with the incidence of taxation on the suddenly increasing quantities (there is a consumption tax on table salt), a trouble which will soon disappear. The recently developed electro-alkali-chloride industry will only be unfavorably affected by the war in the same measure as other German industries by the scarcity of labor and increased cost of fuel. There will also be difficulty in placing the whole of the produced chlorine—a point in favor of applying a large portion of it to nitric-acid purposes. The existence of the great Badische Analin und Soda Fa-

brik is a sufficient guarantee that Germany will win so far as the supply of synthetic ammonia (Haber's method) is concerned, and that, too, even if agriculture is forced, owing to lack of nitrates, to take the whole of its requirements in the form of ammonia salts.

Equally important to agriculture are the phosphates. There is really no danger of any shortness in this branch in Germany, though it is quite possible that materials other than those hitherto used will be resorted to. Less phosphate will be available from bone, which is so largely imported from abroad during normal times. Nor will there be the usual supply of phosphorite from Algiers, Florida, the Carolinas and the South Sea Islands after the present stock has been used up for manurial purposes. Probably one will be referred to the numerous small, less valuable and abandoned German phosphorite deposits, such, for instance, as are found in the valley of the Rhine. The Thomas slags, whose output will not be affected by the war, will also furnish material rich in phosphoric acid. The want of many metallic combinations will be much felt, especially salts of quicksilver, copper and nickel. A quantity of the two last-mentioned metals is produced in Norway, and which can perhaps benefit the German market. There are also nickel deposits both in Hungary and Italy, which, if of little consequence in normal times, may be of importance when there is no nickel to be had from New Caledonia, Canada and the United States. There will, likewise, be a pinch as regards chrome preparations, the raw material coming, in ordinary times, from the Caucasus and Asia Minor.

French bauxite has hitherto been mostly in use as a raw material for aluminum. It must now be replaced by raw material from Dalmatia, which, being of a somewhat different componency, requires different treatment. Possibly as a last resort, German kaolins will be resorted to. As regards iodine preparations, so important during war, the whole of the world's product is in the hands of a syndicate, which, naturally enough, is in a position to meet a considerably increased demand. But here, also, all depends upon the location of the syndicate reserves.

The brown-coal industry has a good time during the war. There is an excellent demand for its benzenes, oils and paraffin. The imports of Caucasian and American mineral oils have ceased, while those of Roumania and Galicia can, with difficulty, meet the greatly increased demand. It is fortunate, however, that the Galician and Roumanian products are available, as the brown-coal industry could not, alone, suffice. Nor are the meager German mineral-oil fields of any importance, except perhaps those of Jegernsee (Bavaria), which, it was formerly said, should be reserved for the event of war. As regards distilled coal tars, the conditions are very fortunate, as in that branch, with the aid of coke production, one is independent of the foreign article. There is absolutely no lack of benzol, which often replaces benzine as a motor fuel. Less abundant are toluol and xylol, as these ingredients are only found in small quantities in coke tar. Toluol's nitro association, trinitrotoluol, is of importance in the manufacture of explosives.

Formerly phenol played a great part as an antiseptic in war, but as such it is now almost obsolete; but the price of carbolic acid has risen so considerably since the outbreak of the war that manufacturers have begun to consider seriously the synthetic production of phenol. It is for the production of the important explosive ingredient picric acid that phenol is used. Naphthalene is the richest product of tar, and there will, therefore, be no lack of supply here. With nitro association, it is an important article in the explosives industry. The consumption of naphthalene in the dye factories in normal times is so large that the quantity now at liberty, owing to the curtailment of the above-named industry, is alone more than sufficient to meet the requirements for the manufacture of explosives. Of anthracene (used only for colors) there will certainly be a superfluity during the war. So far as the tar-dye manufacture is concerned, one may count on a reduction of about one-half of the normal production. Germany is here better placed than her enemy countries, who will lack the colors hitherto obtained from her. This applies especially to England and France, whose textile industries have been dealt a heavy blow and must remain at a standstill and helpless until such times as they can again be put on their legs, which, owing to the very nature of the manufacture, cannot be effected in a hurry.

Inter alia, the professor is of the opinion that England's attempt to promote a home dye industry will prove a costly experiment. Knitted to the color industries are the synthetically produced healing applications. In this industry Germany is independent of outside supply, and the factories concerned will be fully employed during the war. In the domain of soaps, perfumes, etc., the cheaper kinds can be produced synthetically, while the others, hitherto dependent on natural raw material from abroad, can be supplied from natural home products. The large camphor consumption is no longer dependent on Japan (Formosa), as camphor can be produced from turpentine.

Finally, the professor mentions that the cyanide industry will certainly not be able to market its large output, of which the bulk would otherwise have been exported. On the other hand, he is consoled by the reflection that foreign consumers will be affected to a much greater extent. The South African gold fields, for instance, were quickly disturbed in their operations as soon as the cyanate-free sodium-cyanide supply from Germany ceased.

New Chart of Knik Arm, Alaska

A publication of interest at this time is a large scale (1:40,000) chart, No. 8557, of Knik Arm above Fire Island, at the head of Cook Inlet, Alaska. This chart is in preparation by the United States Coast and Geodetic Survey in anticipation of the greatly increased traffic to that locality due to the extensive railroad construction to be inaugurated by the Government Alaskan Engineering Commission this summer. The chart is on a sufficient scale to serve as a harbor chart for vessels with railroad supplies to be landed at Woodrow Creek, and includes all surveys to date, including the resurvey by the steamer "Explorer" in 1914. Woodrow Creek is the name now authorized for what was formerly called Ship Creek.

This chart will be ready toward the end of May, and copies may then be obtained at nominal cost from the superintendent of the Coast and Geodetic Survey, Department of Commerce, Washington, D. C., or at any of the branch offices or sales agencies of that service.

Details of Practical Mining

Azimuth Observations on Polaris by Daylight

Polaris may always be found in clear weather as soon as the sun has set, and frequently for 5 or 10 min. before sunset or after sunrise, according to Robert V. R. Reynolds in *Engineering News,* Apr. 22, 1915. It is stated on good authority that under favorable conditions an observation has been successful as late as 10 a.m. In the northern parts of the United States the cross-wires may remain visible for a long time after sunset.

For the novice it is often difficult at the first few attempts to see Polaris while the sky is still bright, but having once found the star, which appears as a small white dot in the field, he will never thereafter feel in doubt. Tabulated settings (such as accompany this article) sufficiently accurate to bring the star into the field are required, but there remain several factors which must be given consideration before success can be assured:

TABLE TO FIND POLARIS BY DAYLIGHT

Hour Angle of Polaris Approximate† (Use Suitable Interpolations)	Azimuth Setting N.E. or N.W. Depending upon Position of Polaris E. or W. of Meridian	Altitude Setting Latitude Plus or Minus the Tabulated Quantities
0.0 or 12.0	00′	Add to latitude for hour angles less than 6. 1° 08′
0.5 or 11.5	12′	1° 07′
1.0 or 11.0	24′	1° 06′
1.5 or 10.5	36′	1° 04′
2.0 or 10.0	47′	1° 00′
2.5 or 9.5	57′	55′
3.0 or 9.0	1° 06′	50′
3.5 or 8.5	1° 15′	43′
4.0 or 8.0	1° 22′	35′
4.5 or 7.5	1° 27′	27′
5.0 or 7.0	1° 30′	18′
5.5 or 6.5	1° 33′	09′
6.0 hours	1° 35′	00′ Subtract from latitude for hour angles exceeding 6.

†The hour angle used as the argument in this table needs only to be approximate. If it is correct within 5 min. of time, sufficiently accurate settings will be indicated provided interpolation is made. Hence, there is no need of correcting for longitude until the surveyor has made the observation and is preparing to enter the table of azimuths of Polaris.

The table is computed for a mean latitude of 42°, but purposely modified slightly to make it more useful along the 49th parallel, where much of the Forest Service work is being done. It is accurate enough to bring Polaris within the field of an ordinary transit between latitudes of 10° and 58° N. It is not for use to determine the true azimuth after the observations.

1. A slight haziness, which may hardly be obvious to the eye, is sufficient to conceal the star until darkness comes on.

2. The telescope must be in exact focus for celestial objects. This may be accomplished either by focusing at night upon the moon and making a slight scratch upon the objective slide to show the point to which it should be extended, or the surveyor may focus at the time of observation upon a well-defined object three or four miles distant, which focus will usually be found sufficiently close. Accurate focusing is one of the most important factors in finding the star.

3. For the purpose of cutting off objectionable light, the sunshade should always be attached. Certainty of finding the star is assured by throwing a coat or other dark cloth over the head when searching through the telescope, as a photographer uses a focusing cloth.

4. An approximate meridian must be had, from which the azimuth settings are turned off. Commonly, the surveyor will already have such a meridian from his backsight. Otherwise, a meridian determination from a solar attachment in reasonable adjustment will suffice. Sometimes, when the magnetic declination is closely known, it will even be possible to turn upon the star from the needle. A reference meridian which is true within 5′ or 10′ will be precise enough to locate the star when the table of approximate settings is used.

Polaris having been found, the angle from the reference mark to the star should be measured twice, the second time with the telescope inverted. The mean time of observation and the mean angle are then used to find the azimuth of the mark by the simplified hour-angle method. There is practically no chance that any other star will be seen and mistaken for Polaris.

Inclined Shaft for Timber

By L. D. Davenport*

For a small mine on the Mesabi, where the overburden is shallow, the inclined timber shaft or timber slide seems to have several advantages over the usual vertical shaft. First, only one top man is required to send down timber instead of two; second, no rope, windlass or headframe is needed; third, it makes an easy and safe entrance to the mine.

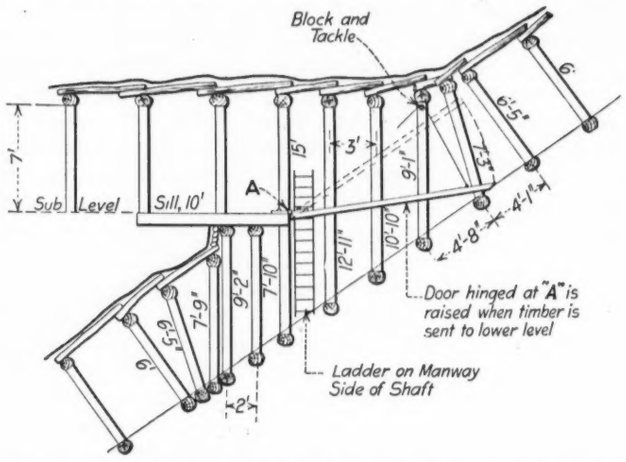


Fig. 1. Arrangement of Sets at Intersection of Incline and Sublevel

This description applies to the latest inclined timber shaft sunk by the Oliver Iron Mining Co., but there are a number of inclines in use at other mines in this district which are similar.

Fig. 1 shows the arrangement of the sets where the incline intersects the top sublevel and Fig. 2 shows the details of the timbering, the stairway and the timber slide. A door made of double thickness of 2-in. plank deflects the descending timber or lagging to the top sublevel. When it is desired to send timber to the lower level this door is raised by means of a block and tackle fastened to one of the caps as shown. The free end of the rope is led to the stairway side of the shaft, where it is pulled. A vertical ladder against the side of the shaft connects the sublevel and the stairway.

This shaft has a dip of 35° and is 110 ft. deep along the slope. Timber travels down the slide faster than is necessary. In another mine the timber tends to hang up on a 90-ft. incline which dips at 29°.

*Assistant chief engineer, Oliver Iron Mining Co., Hibbing District, Mesabi Range, Minn.

Fig. 3 shows the details of the headframe used in sinking the shaft. Two 9x16-in. by 28-ft. timbers supported by two bents of round timber carry the rails. The dump is made of 6x8-in. timber faced with 5/8x3-in. flat iron. The skip was made from a tramcar box with the end door removed and bail and wheels fitted to it. The rear wheels have a wide tread to pass the dump and the sides of the box are cut back as shown.

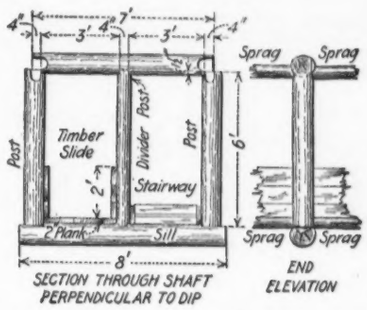


FIG. 2. DETAILS OF TIMBERING

The shaft was lined up by stakes on the surface at first and then from lines hung from spads in the caps. The proper grade was kept by means of a straightedge and a triangular template on a 35° angle, having a level set into it. The shaft was sunk through the overburden to the ore. To avoid hoisting any ore a raise was holed through from below and trimmed out; the timbering was then carried to the bottom. When the shaft was completed the headframe was removed and a small shed with three walls and a roof was built over the collar.

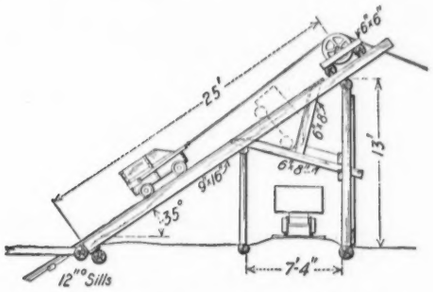


FIG. 3. HEADFRAME USED IN SINKING

Locked Signal System

BY H. H. HODGKINSON*

The signal system installed in the Palmer shaft of the New Jersey Zinc Co.'s mine at Franklin, N. J., by R. M. Catlin and designed by L. G. Rowand is unique and has many decided advantages over other signal devices. A signal box is located at each shaft station and is operated by a lever on the side, to which is attached a short chain and handle to facilitate pulling the lever. The cage, however, is moved only on signal given to the engineer by a man who carries a key to the device and who travels with the cage.

The signal boxes are situated at each station in such a position as to be easily accessible to the cage conductor and enable him to see his cage constantly, thus minimizing the danger of mishaps from the cage moving while men are getting on or off.

In operating, the pull and release of the lever ring the gongs in all other signal boxes, but do not ring the engineer. Thus it is always possible to signal for the cage from any station in the shaft and to notify anyone about to ring a signal from any other station that there is already a signal being rung, thus preventing confusion. As soon as the cage conductor receives a signal—provided there is nothing to prevent him from bringing the cage to the station from which the signal was rung—he inserts a special key in the lock on the front of the box and turns it, thus connecting the one signal box with the engineer's signal in the engine house. He then signals the engineer by means of the requisite number of pulls on the lever; this signal at the same time rings at each station, notifying the persons who rang the original signal that the cage is coming. The conductor remains at the signal box with his key in the lock waiting for the engineer to repeat his signal. If the engineer repeats correctly, the conductor removes his key, climbs on the cage and proceeds to the station signaling. If, however, the signal rung back by the engineer happens to be wrong, the conductor rings one bell to the engineer to stop and the exchange of signals is repeated. There is always ample time allowed the cage man to remove the key and climb on the cage.

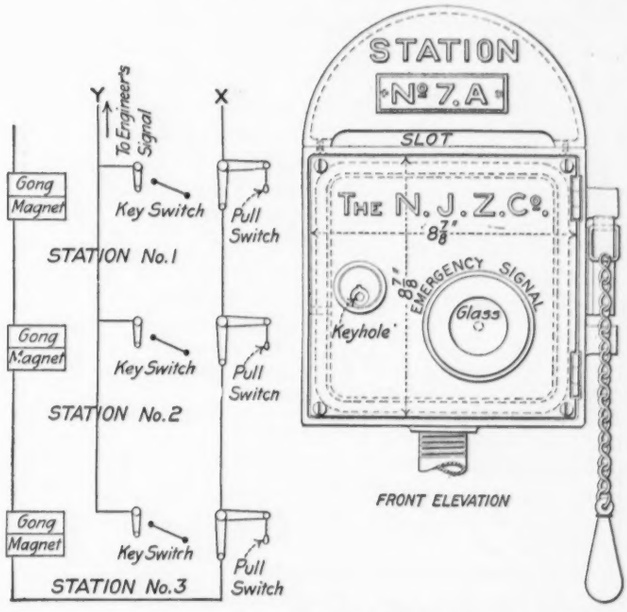


FIG. 1. DIAGRAM OF SYSTEM AND ELEVATION OF SIGNAL BOX

Fig. 1 is a diagram of the system. This consists of the two circuits *Y* and *X*. Through circuit *X* there is a constant current flowing which causes the electro-magnets to operate the clappers of the gongs in the signal boxes when the pull switch is thrown. It will be seen that this operation does not operate the engineer's signal. Through the circuit *Y* there is no current, and when the key switch is thrown the signal box is merely connected to the engineer's signal, which cannot ring until the pull switch is also thrown, causing the current to pass through circuit *Y* and operate the engineer's signal.

The signal boxes are constructed of cast iron as shown in Fig. 2. The front of the signal box is in the form of a door to permit repairs to be made inside. It is locked by means of the same key which operates the engineer's signal, in addition to being fastened by a screw in each corner. The doors are fitted on the inside with a 3/8-in.

*Mining engineer, Franklin Furnace, N. J.

round rubber gasket to prevent water from getting into the boxes. The locks are so constructed that it is impossible to remove the key and leave the key switch thrown and the signal box connected to the engineer's signal.

On the door of the signal box an emergency signal device is placed so that the cage can be stopped immediately in case of an actual or threatened accident. This consists of a brass pin held in place by a round piece of window glass, which when broken permits the pin to be forced outward by means of a spring, making the same connection as the key switch would. The lever is then pulled once, which will bring the cage or skip to a stop if in motion.

The gong is placed on top of the signal box proper and over it is bolted a tightly fitting cast-iron cover, which prevents any water from working its way inside. The cover has a ½-in. slot on the front and sides to enable one to hear the gong more distinctly.

The lever *A* which operates the pull switch is situated on the outside of the box and has its movement confined to the space between the two lugs *L L* to prevent any injury to the switches inside.

The pull-switch lever *C* in the position shown permits the current to pass to the electro-magnet which holds the clapper up against the gong. When the lever *A* is pulled down, the lever *C* assumes the position shown by the dotted lines, which breaks the circuit *X*, causing the clapper to drop and at the same time closes the circuit *Y*, when the key switch *K* is thrown, and thus rings the engineer's signal. Upon releasing the lever *A* it is returned to its normal position by the spring *S*, Fig. 3, the circuit *X* is closed again, causing the clapper to strike the gong, and the circuit *Y* is broken as before.

The spring *S* is fastened to the short lever *B*, which operates the shafting *E*, to which the lever *A* and the switch lever *C* are attached.

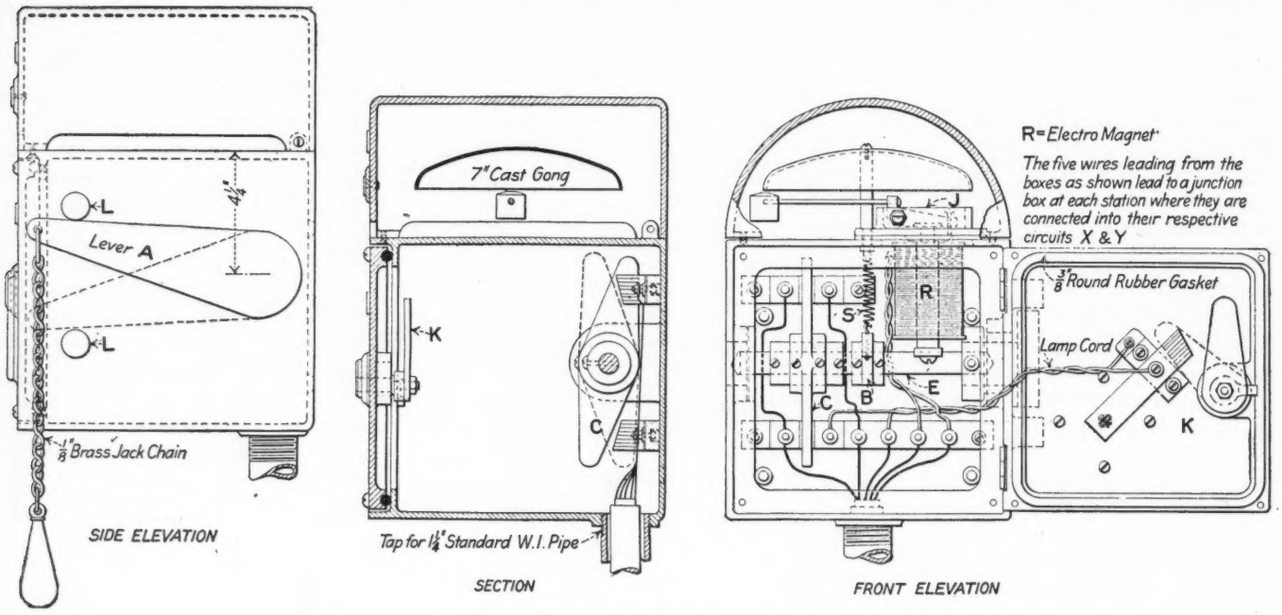


FIG. 2. SIDE ELEVATION AND INTERIOR OF SIGNAL BOX

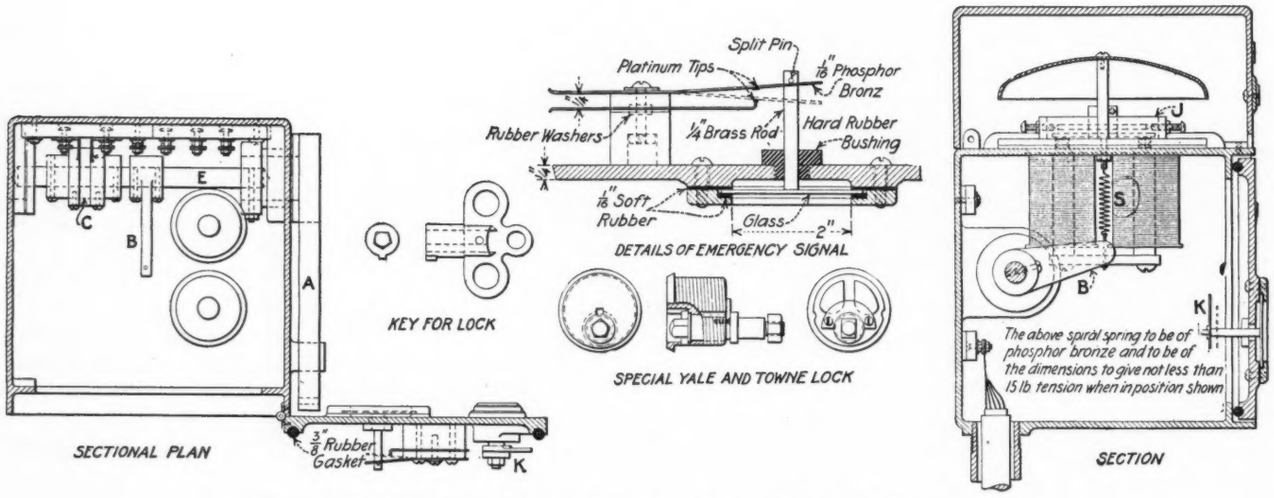


FIG. 3. DETAILS OF SIGNAL BOX AND SAFETY LOCK CONNECTIONS

The Rivers of the United States Carry to Tidewater Every Year 270,000,000 tons of dissolved matter and 513,000,000 tons of suspended matter, according to the U. S. Geological Survey. This total of 783,000,000 tons represents more than 350,000,000 cu.yd. of rocks, or 610,000,000 cu.yd. of surface soil.

Details of Milling and Smelting

Allaying Dust on Tailings Dumps

An investigation looking toward the prevention of flying dust from tailings piles has been under way at several of the Rand properties[1]. The necessity for a remedy of this condition has been accentuated of late years by the finer grinding now being done in tube mills. The wind, carrying the loose, dry particles from the dump, produces a condition annoying to workmen and destructive to machinery. Experiments have been made using a solution of molasses; silicate of soda, in the form of slag; lime grouting, and many other possible mediums; but no great success has been obtained. An emulsion of black clay and water was then tried, which gave a successful result. The emulsion was made up in a mixing machine, and pumped through a plunger pump to a sprayer, which distributed the emulsion on the dump. The ratio of solids to water was about 5:1. This covering has proved effective for 16 months, during which time it has been subjected to the test of high winds and heavy rains. The dump treated was at the East Rand Proprietary Mines.

Rules for Cranemen*

Personal caution is the greatest safeguard, after all. The careless craneman, although provided with the best facilities for safe handling of materials, may by his carelessness thwart the most careful plans of the management for the safety of its employees. Similarly, the craneman who is well meaning but not thoroughly familiar with the cause and effect of right and wrong applications of the crane mechanism may blunder into a most disastrous accident. It is therefore imperative that cranemen should be thoroughly impressed with safe ways of handling the cranes under their charge.

Traveling cranes which are operated from a cage attached to the crane bridge are liable to cause more frequent and more serious injuries than other types because the former usually carry heavy loads at considerable speed over great areas of floor upon which employees are engaged in work. Most cage-operated cranes are electrically driven. The rules suggested below, therefore, are especially designed for electrically driven, cage-operated traveling cranes.

Satisfactory crane rules are in effect in many plants, yet they differ in language and in details. A number of these have been gathered and studied, while close observation of crane hazards in all kinds of plants has suggested others.

Not all of these rules, however, are applicable to every cage-operated, electrically driven crane in every plant, because of the great variety of such cranes in service and the many different conditions under which they must operate. These rules, if not adopted in their entirety, may nevertheless be used as a foundation upon which a set of rules may be formulated for each plant to suit local conditions; they may even suggest rules for operation of other types of cranes as well.

It is recommended that the rules be printed and copies posted conspicuously in each operator's crane cage and placed in the hands of all cranemen. When once adopted, the rules should be rigidly enforced.

General Rules for Cranemen

(1) Cranes must be operated only by regular crane operators, authorized substitutes, crane repairmen or inspectors; no one else should enter crane cage.

(2) Access to and exit from the crane cage should always be by stationary ladders, stairways or platforms provided for the purpose. Cranemen must keep their hands free when going up and down ladders.

(3) Articles which are too large to go into cranemen's pockets or belts should be lifted to or lowered from crane by hand line kept in cage for such use.

(4) Cages should be kept free of clothing and other personal belongings. Tools, extra fuses, oil cans, waste and other articles necessary in the crane cage should be stored in a tool box, and not left loose on or about crane.

(5) A pail filled with sand should be carried in the crane cage for use in case of fire.

Rules for Crane Operators

(6) Operator should familiarize himself fully with all crane rules and with the crane mechanism and its proper care. He must not tamper with any mechanical or electrical adjustment, but if adjustments are necessary, he should report the same at once to foreman or repairman.

(7) Operator must not eat, smoke or read while on duty, nor operate crane when he is in poor physical condition.

(8) Operator must be constantly alert in watching crane and floor operations, and workmen under or near the load.

(9) Operator or some one specially designated by the foreman must daily oil all working parts of crane, including sheave blocks, fill empty grease cups, turn down others and make sure that oil passages are not clogged. Hoist chains and cables must be lubricated regularly as directed by foreman.

(10) Operator must examine crane daily for loose parts or defects and report same immediately to foreman or repairman.

(11) Operator must clean crane weekly or oftener if necessary.

(12) Operator must test foot brake and limit switch at beginning of each working period.

(13) Operator must avoid, as far as possible, carrying loads over workmen; it must be absolutely avoided when carrying molten metal.

(14) Operator must lift loads only high enough to clear safely all men and obstacles upon the floor.

[1] "Journ. Chem. Met. and Min. Soc. S. A.," February, 1915.

*"N. F. A. Safety Bulletin," Aug. 1, 1914.

(15) Whenever loads are to be carried over a long distance to a high position, they should be carried as close to floor as feasible until final location is reached; load should then be lifted to desired height.

(16) Operator must never go or allow any one else to go on crane bridge without first opening main switch; if crane is provided with an emergency switch, that also must be opened. Preferably, switch must be locked open, or warning sign placed and kept upon it, while any person remains on the bridge.

(17) Whenever operator finds main or emergency switch open, he must not close it, even when starting on regular duty, until he has made sure that no one is on or about the bridge or runway.

(18) Before closing main switch, operator must make sure that all controllers are in OFF position.

(19) Operator must move controllers slowly from point to point to increase speed of motors gradually, and must restrict speed until slack in chain or cable has been taken up.

(20) In case of electrical short circuit or if a controller should stick, operator must immediately throw all controllers, except the one that sticks, into OFF position, then open main switch with a rapid motion and notify foreman or repairman.

(21) If power goes off, operator must immediately throw all controllers to OFF position until power is again available.

(22) Operator must not run more than two motors at one time; when handling molten metal it is advisable to run only one motor at a time.

(23) Operator must not reverse a motor until it has come to a full stop, except to avoid accidents.

(24) Operator must pay special attention to the block when long hitches are made, to avoid tripping limit switch or running block upon the drum. When it is necessary to hoist beyond limit switch, operator must first secure foreman's approval.

(25) Operator must not lift or suspend a load when there are less than two full wraps of cable or chain upon the drum.

(26) Operator must recognize signals only from the one man who is supervising the lift. Operating signals should follow an approved standard; they should be manual, never verbal. Whistle signals may be used where one crane only is in operation.

(27) Before starting to hoist, operator must place trolley directly over load to avoid swinging it when being hoisted. This precaution is especially important when handling molten metal.

(28) Operator must not make side pulls with crane except when especially instructed by foremen.

(29) Except on order of foreman, operator must not lift load when operation of controller shows that load is excessively heavy.

(30) When handling maximum loads, particularly ladles of molten metal, operator must test hoist brakes after load has been lifted a few inches; if brakes do not hold, load should be lowered at once and the brakes adjusted or repaired.

(31) If hoist brakes refuse to hold while crane is handling molten metal, it may be necessary, in order not to interrupt the pouring operation, to sustain load by short upward movements of hoist, to counteract settling of load.

(32) Bumping into runway stops or other cranes must be avoided. When operator is ordered to engage with or push other cranes, he must do so with special care for safety of persons and cranes.

(33) When two or more cranes are used in combination to lift one load, the several operators must be careful to lift load evenly.

(34) When lowering a load, operator must proceed carefully and make sure that he has load under safe control at all times.

(35) When leaving cage, operator must throw all controllers to OFF position and open main switch.

(36) If crane is located outdoors, operator must also lock crane in secure position to prevent it from being blown off or along the track by severe wind.

(37) In all doubtful cases operator should consult foreman or inspector.

Rules for Floormen

(38) Floorman shall give all signals to the operator in accordance with approved standards.

(39) Floorman shall be responsible for the condition and selection of all hoisting accessories and for all hitches.

(40) Before operator moves crane upon which empty chain slings are hanging, floorman must hook both ends of slings to block.

(41) Floorman shall whenever possible walk ahead of moving load and warn people to keep clear of it. He shall see to it that load is carried high enough to clear all obstructions.

(42) Floorman must notify the foreman in advance when an extra-heavy load is to be handled.

(43) Floorman should not himself ride or allow others to ride on hook or load except upon authority of foreman.

Rules for Repairmen

(44) Repairman should have crane that is to be repaired run to a location where the repair work will least interfere with other cranes and with operations on floor.

(45) Before starting repairs, repairman must see that all controllers are thrown to OFF position, that main switch and emergency switch are opened and that, except for short time repairs, all fuses are removed.

(46) Repairman should immediately place red flags or OUT OF ORDER signs on crane to be repaired and approved warning signs on floor beneath. Where feasible, space under crane should be roped off. If other cranes are operated on the same runway, he must also place rail stops at a safe distance.

(47) Before removing any part which may release hoist block, repairman must run block to floor, or if this is not possible, he must wedge the gearing to prevent drum from unwinding.

(48) When repairing runways, repairman should place rail stops and red flags at both ends of section to be repaired.

(49) Repairman must take care to prevent loose parts from falling or being thrown upon floor beneath.

(50) Upon completion of repairs, craneman must remove all blocking and all loose parts, bolts and tools, and put the crane in operating condition. He must then remove rail stops, red flags and warning signs and turn the crane over to operator.

Personal caution is the greatest safeguard, after all.

Company Reports

Hollinger

For 1914 the Hollinger Gold Mines, Timmins, Ont., reports a profit of $1,611,058, after deducting $165,621 for depreciation. Dividend payments amounted to $1,170,000, making a total of $2,610,000 paid to date in dividends from 393,422 tons of ore yielding $6,134,339, or an average of about $15.30 per ton. Of the profits reported for 1914, apparently $312,302 was spent on plant and development and added to capital accounts. The capacity of the mill is being increased from 500 to 1600 tons a day. During the year 208,936 tons of Hollinger ore were treated, averaging $13.67 per ton. The total cost as reported follows:

	Per Ton Ore Milled
General charges	$0.197
Administration and management	.243
Taxes	.209
Insurance	.096
Clearing surface, roads, etc.	.032
Operating camp	.128
Operating boarding house	.048
Exploration	.056
Development	.403
Ore production	1.646
Milling operations	1.184
Mill alterations	.035
Alterations to plant	.019
Marketing bullion	.059
Fire protection	.021
Prospecting	.002
Loyal-service bonus	.043
	$4.421
Depreciation of plant	.792
Total cost	$5.213

Development work totaled 10,622 ft. and there was 2200 ft. of trenching done. Of the ore hoisted, 78.2% came from stopes and 21.8% from development. Ore reserves are estimated to contain 1,162,960 tons of ore, averaging $11.49 per ton. A diamond-drill hole was put down 2000 ft. on the incline, or 1425 ft. vertical, and it has shown that there is no change in rock formation or vein characteristics to a depth of 1425 ft. It is stated that as a result of drilling it may be anticipated with considerable assurance that operations will continue to a depth of 1500 ft., with strong possibilities of greater depth. A bonus system has been adopted which gives a bonus of 15c. a day after one year's service, 30c. a day after two years' and 45c. a day after four years' service. The vital parts of the works have been fitted with automatic sprinklers for protection against fire at a cost of $51,955. Additions to the mill will require extra expenditure for fire protection.

A summary of the accident and sickness report of the hospital shows that there were nine cases of typhoid, four of rheumatism, four of la grippe, two of stomach and intestines and six of throat and lungs. Of accidents there were 106 minor accidents entailing a loss of time and one fatal accident, which occurred while the victim was riding a cage. The greatest number of minor accidents from a single cause was 14, from falling rock; 11 were injured drawing ore from chutes and 10 slipped and fell while walking, seven were hurt handling cars, five caught between cars and chutes, while only one was injured from drilling into a missed hole. One accident is noted where a mill hand was disabled for five days on account of scalding his arm while washing his hands. Another occurred to a laborer from carrying his knife open in his pocket. The longest period of disability was nine months, from a broken leg, and the next longest eight months, from a broken arm. Only 34 of these accidents would have come under the new Workmen's Compensation Act which is now in effect.

Portland

The Portland Gold Mining Co., Cripple Creek, Colo., reports a profit of $590,594 from 273,129 tons of ore during 1914. Dividends amounting to $360,000 were paid. The total production of the Portland from April 1, 1894, to Dec. 31, 1914, was 2,040,721 tons, having a gross value of $38,274,952. From this dividends amounting to $9,817,080 have been paid. Balance of quick assets amount to about $750,000, which added to the dividends would make a total profit of about $10,567,000. This would indicate a total cost of $27,707,000, or about $13.60 as an average cost per ton of ore to date. According to figures given the average grade of ore to date is $18.70 per ton.

During the year 15,592 ft. of development work was performed, making a total of 272,779 ft. to date, or about one foot for every 7.5 tons of ore produced. The cost of development per foot during 1914 was: Drifts, $6.62 per ft.; crosscuts, $6.99; raises and winzes, $7.77; 183 ft. of shaft sinking, $62.83; and 155 ft. of shaft sinking, $50.78 per ft. The cost of shaft sinking includes all timbers, guides, wiring, piping, chairs, and everything ready for use. A statement of mining costs as given in the report follows:

STOPING

	Per Ton		Per Ton
Breaking ore—		Assaying and sampling	$0.033
Labor	$0.361	Surveying	.015
Explosives	.177	Repairs, etc.	.200
Machine drills	.119	General expense	.109
Tramming	.189	Office expense	.019
Timbering—			
Labor	.214	Stoping ...278,993 tons	$1.905
Timber	.128	Development 55,820 tons	2.352
Hoisting	.161		
Sorting and loading	.160	Total ...*334,813 tons	$1.98
Lighting	.020	*Crude ore.	

Bingham Mines Co.

The Bingham Mines Co., Salt Lake City, Utah, reports earnings of $172,530 for 1914. Of this $60,280 came from the earnings of the Dalton & Lark and Commercial mines of Bingham, Utah, and $104,250 from dividends received from the stock of the Eagle & Blue Bell, of Tintic, Utah, owned by the company. The operating statement of the Dalton & Lark and Commercial mines shows a production of 49,780 dry tons of ore, having a gross value of $291,787, from which $80,490 was deducted by the smelters for freight, sampling, assaying and smelting. The net smelters' returns were $211,297. The

metal contents of the ore were: 3613 oz. of gold, 188,905 oz. of silver, 3,738,773 lb. of lead and 1,110,762 lb. of copper. The company now has outstanding $587,000 of first-mortgage 6% convertible bonds.

Crown Reserve Mining Co.

The Crown Reserve Mining Co., Cobalt, Ont., for 1914 shows a gross ore production of $740,092. The operating expenses were: Mining, development and depreciation, $286,757; Dominion Reduction Mill charge, $131,619; smelting charges and deductions, $17,219; bonus to employees, $13,212; royalty to Ontario Government, $51,808—total, $500,615, leaving a profit of $239,477 from the mine. In addition to the operating profit the company received $144,000 in dividends from its holdings in the Porcupine-Crown mines and $3832 in interest, making total profits for the year $387,309. There were other expenditures, for legal expenses and development of outside properties, amounting to $35,698, so that the net income for the year was $351,611. Dividends aggregated $424,515. Dividends to date amount to $5,996,279, and the company has paid the Ontario Government $861,834 in royalties.

There were 1,426,320 oz. of silver produced from 287.75 tons of high-grade ore and 31,347 tons of mill ore. There were 40,842 tons broken in the mine and 4056 ft. of development work performed. The following table shows the cost per ounce of silver as reported:

	Cents
Mining and development	8.70
Power, heat and light	1.90
Maintenance of plant	1.40
Ore handling	1.96
Mine, general expense	2.02
Superintendence	0.75
Smelter charges	1.27
Milling charges	9.00
Depreciation, head office, traveling	1.95
Total mine cost per ounce	28.95

The average price received for silver was 51.92c. per ounce. The high-grade ore averaged $3474 per ton and mill ore, $15. Mine bullion averaged 0.971 fine and mill bullion, 0.956 fine. The total production of the Crown-Reserve to date is 18,429,141 oz. at an average cost of 13,675c. The price received was 54.57c. per oz.

Daly-Judge

The Daly-Judge Mining Co., Park City, Utah, reports a profit of $127,803 for 1914 and dividend payments of $180,000, thereby reducing its cash balance $52,197. The following table gives details of production and selling price of the ore after deducting freights, smelting charges, losses, etc.:

FOR 1914

	Tons	Ag Oz.	Au Oz.	Pb %	Cu %	Zn %	Fe %	Sold for
Crude ore	5,606	29.65	0.027	19.29	1.51	12.37	7.40	$21.35
Concentrates	12,453	24.01	0.04	29.19	0.87	11.66	18.02	25.48
Zinc middlings	4,142	13.24	0.018	2.93	...	42.85	7.77	17.36

The ore statement shows that there was 54,701 tons of crude ore extracted from the mine, of which 5606 tons was shipped direct to the smelters and 49,095 tons was concentrated. The cost of extracting the ore from the mine was $3.067 per ton. Concentration costs were $0.763 per ton of ore concentrated. General expenses were 44.8c. per ton of ore extracted. Marketing expense amounted to $1.124 per ton on 22,201 tons marketed. The total operating cost reported was $4.656 per ton extracted; but in addition to this cost there were expenditures for prospecting, exploration and dead work amounting to $121,946; surveying and engineering, $2160; royalties, $14,646; and drainage, $12,000—a total of $150,752, or $2.74 per ton of crude ore. Adding these costs the total cost would be $7.39 per ton, not including freight, smelter charges and deductions. The ratio of concentration was 4:1 of lead concentrates and 3:1 of all products combined. The mill treated an average of 361 tons a day. Experiments are being conducted in oil flotation for the ores, and the results secured justify further effort. A high saving of the metals has been made with the process, but as yet a satisfactory separation of the concentrates into desirable lead-silver and zinc products has not been obtained.

Porcupine-Crown Mines

The report of the Porcupine-Crown mines, Porcupine, Ont., for 1914 shows a bullion production of $691,394. Expenditures for mining, milling, taxes, depreciation, etc., amounted to $341,092; development and exploration, $42,984; mint charges, $2243; bonus to employees, $5855—total, $392,174. Profit from the mine was $299,120 and interests and sundries made total profits $301,451 for the year. Dividends Nos. 1 to 4 inclusive aggregated $240,000. There were 65,198 tons of ore broken, of which 40,857 tons were milled and 24,341 tons left in the stopes. The average value of mill heads was $17.18, and tails averaged 47c., making an extraction of 97.26%. The mine also produced 11,554 tons of waste, and 4633 ft. of development work was performed. The following table gives the cost per ton of ore milled as reported:

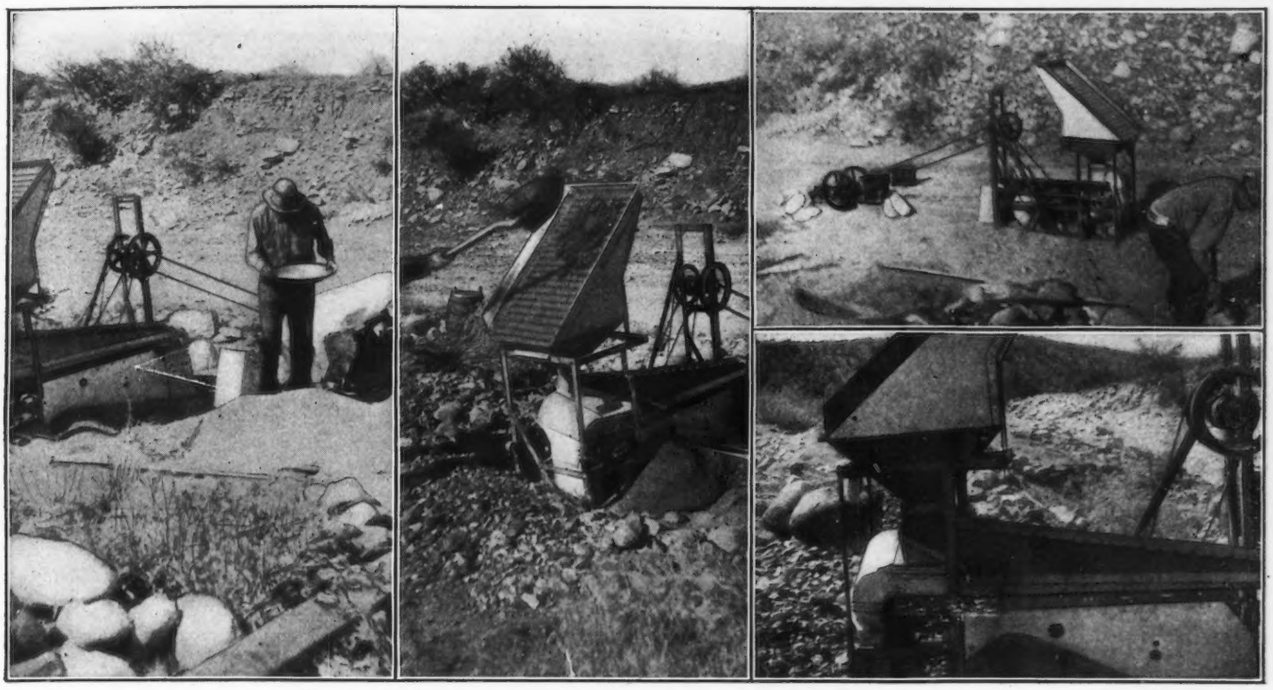
Mining, development, and explorations	$3.20
Hoisting and tramming	.39
Mill operation	1.31
Power, heat and maintenance	1.51
Mine, general expense	1.12
Depreciation, administration and taxes	.76
Total	$8.29
Less 24,341 tons ore broken and not milled	1.20
Cost per ton of ore milled	$7.09

Ore reserves are estimated to contain 85,000 tons of ore valued at $1,510,000. It is estimated that 40,000 tons containing $297,000 were added during the year.

Quincy

The Quincy Mining Co., Hancock, Mich., for 1914 reports a profit of $205,593 from 15,356,380 lb. of refined copper. The total receipts were $2,063,650, of which $12,630 came from the sale of silver and $9028 from interest receipts and the sale of real estate. The total expenses were $1,858,057, made up of $1,372,436 for mining, $132,776 for opening mine, $64,998 for Michigan taxes, $167,696 for smelting, transportation, etc.; $29,787 for strike expense, $76,662 for construction and betterments, and $13,702 for accident account. The total cost of producing copper was 12.1c. per lb. After paying dividends amounting to $55,000, a balance of $897,531 remained on hand at the end of 1914. Dividends paid to date amounted to $20,897,500. The company did not operate at a profit during the first six months owing to the strike, cost of repairs from air blasts, etc. No new construction work was undertaken during the year that could prudently be deferred until a more favorable time. In carrying out the Safety-First movement a physical examination by the medical staff is required before accepting an applicant for a position with the company.

Photographs from the Field

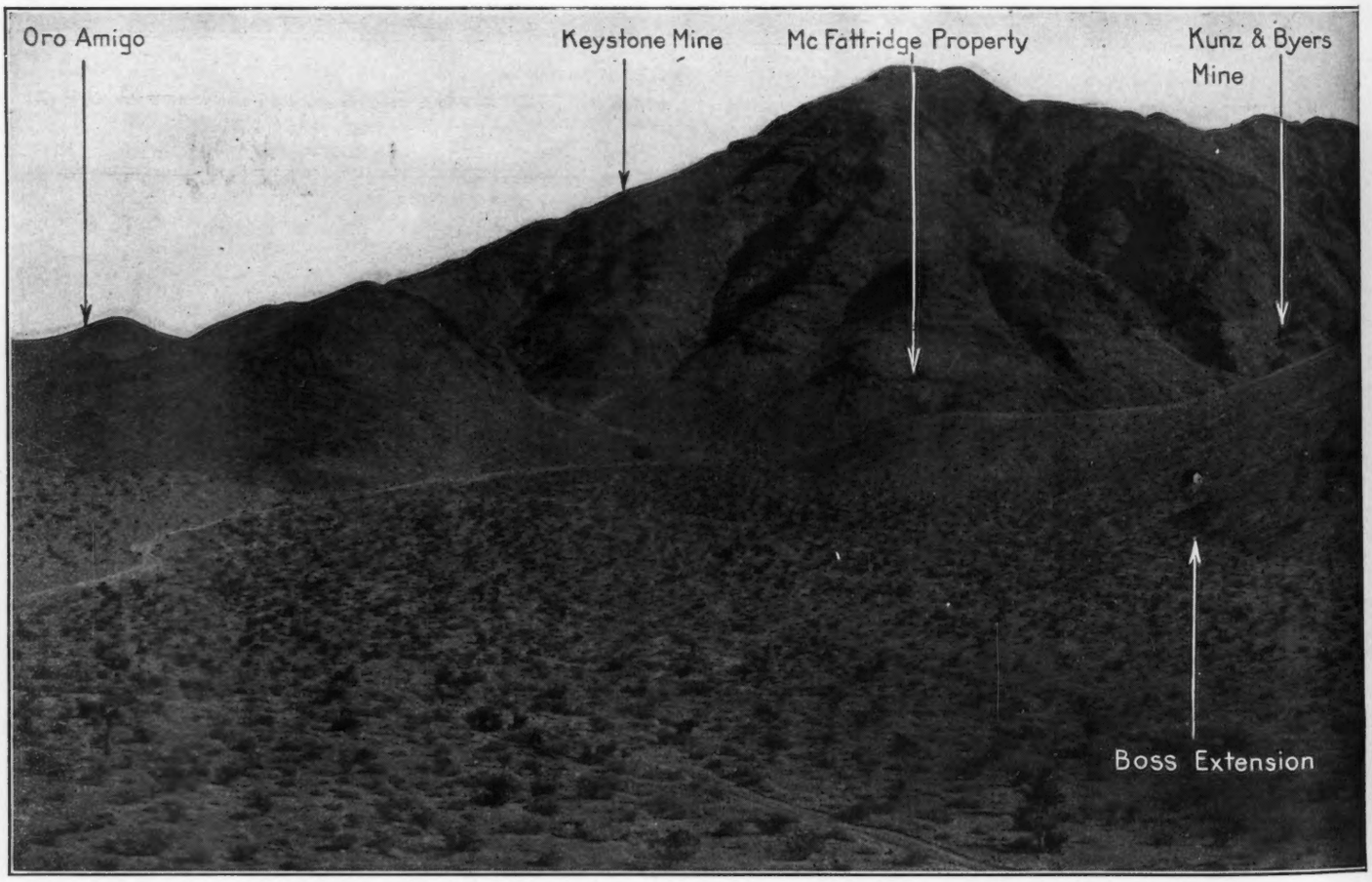


A One-Man Dry-Placer Operation

A machine made by A. H. Stebbins, of Los Angeles, with which the prospector can recover gold in the desert country

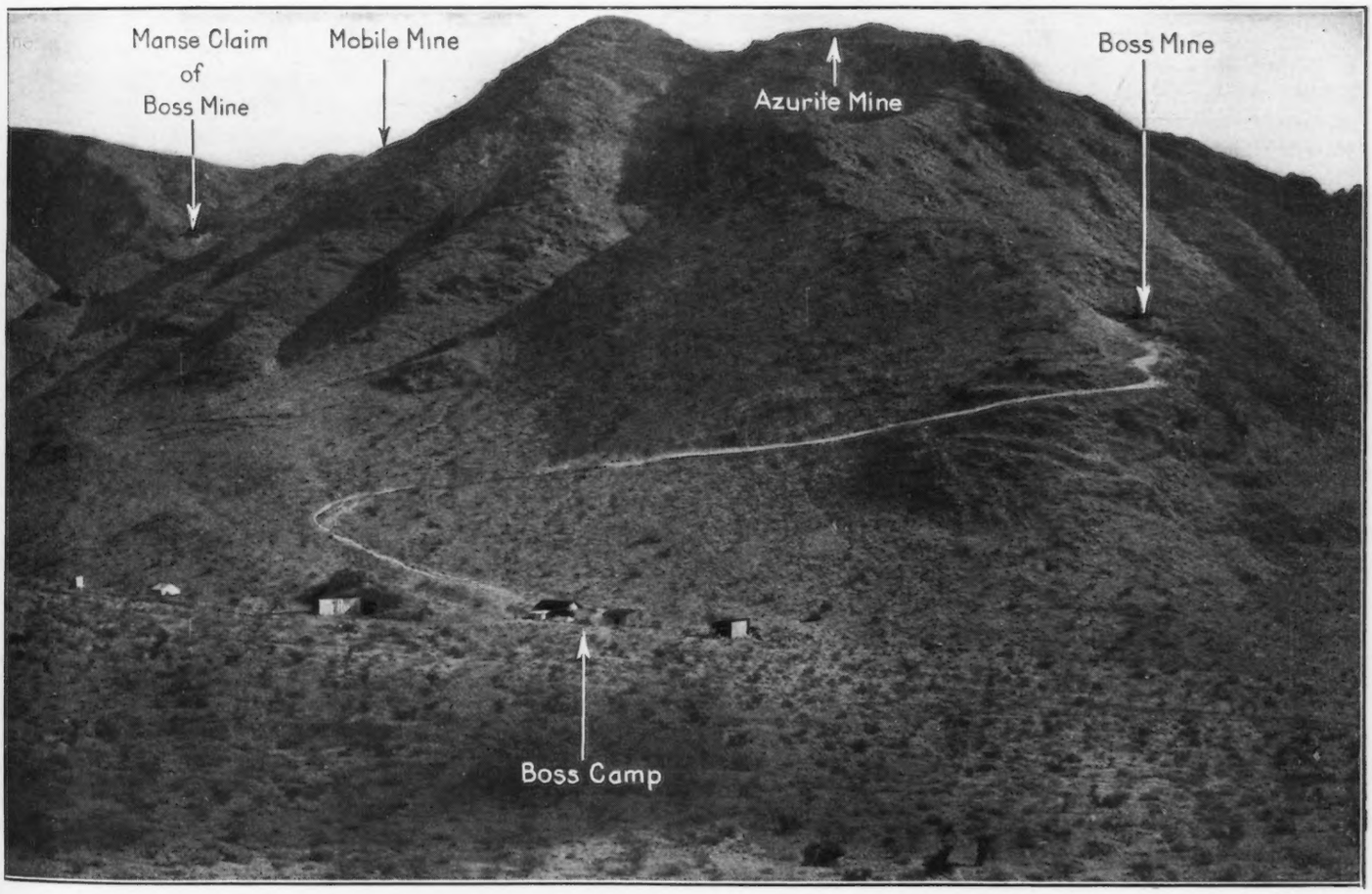
The New Commonwealth Mill at Pearce, Ariz.

MORGAN PARK, THE STEEL CORPORATION'S MODEL CITY AT THE
About 170 houses have been completed, involving about $1,000,000. All are of steel and concrete construction,



VICINITY OF THE BOSS MINE, NEAR GOODSPRINGS,
Scene of the recent important platinum discovery.

PLANT OF THE MINNESOTA STEEL CO., NEAR DULUTH, MINN.
and fireproof. The company plans the construction of an elaborate office building in the near future



YELLOW PINE MINING DISTRICT, NEVADA
The Boss mine produces a gold-platinum ore

Notes on the Zinc Industry in Europe

According to German papers, the Zinkhüttenvereinigung, G.m.b.H., has now been formally organized. Its managers are Herr Schaltenbrand, of Michalkowitz; Geh. Bergrat Dr. Weidtmann, of Aachen, and Director Herkendell, of Köln-Lindenthal. The corporation intends to regulate the production, stocks and price of spelter.

At a recent meeting of the Zinkhüttenvereinigung the price of zinc was raised five marks per 100 kg. The average price in 1914 was 46.03 marks, compared to 45.55 in 1913 and 53.75 in 1912. The present price in Germany is considerably higher than in normal times. This is attributed in part to the increased cost of production owing to the war, many of the zinc miners and smelters being with the colors, while the supply of foreign ore is restricted. On the other hand, there is an increased consumption of spelter in substitution for copper and other metals of which there is a shortage.

The Vieille Montagne smeltery at Angleur, Belgium, is being operated in a small way. According to recent news in German papers, its production is being increased.

[The opinion is expressed in well-informed quarters here that when the war ends the huge stock of spelter that existed in Europe in the middle of 1914 will have been exhausted.

English zinc smelters are increasing their production. England is also obtaining spelter from the smeltery at Budel, in Holland. The production of Trollhättan, Sweden, and Sarpsborg and Ilen, Norway, is supposed to be going to Germany. The smeltery at Mortagne, France, is idle. St. Amand also is probably idle, being within the zone of German occupation. The Malfidano plant at Noyelle-Godault and the Vieille Montagne plant at Viviez presumably are being operated. However, France is manifestly short of spelter, inasmuch as she is a buyer abroad.—EDITOR.]

Iron-Mining Situation in North China

SPECIAL CORRESPONDENCE

The mining situation in the Republic of North China is an interesting one and throws some light on a present diplomatic problem of much importance to this country. In the past there has been a lot of superstition about mining, and therefore the immense mineral resources of the country have scarcely been touched. This condition was fostered a great deal by the late Ching dynasty of the Manchus. The Manchus were in a minority, probably in the ratio of about 1 to 70, and they considered it wise not to encourage mining, as it would tend to bring in foreigners and foreign ideas, which would eventually weaken the Manchu power. This dynasty has now fallen and a new and better order exists. Mining in general seems to be coming to the front and, in some ways, is being made more attractive to foreigners.

There is great need for a native-made iron for use in local manufacturing industries. There are large deposits of iron ore not very far from excellent coal fields, and the combination should make an attractive inducement to progressive capitalists. The most extensively developed field is that near the junction of the Yangtze and Han rivers at Hankow and Hanyang. The Japanese have invested a great deal of capital there, and depend largely on this district for their own supply of iron.

Since the European war began a different complexion has been put on the iron-mining situation, which is causing some concern here. Since Tsingtao has been occupied by the Japanese they have become bold and have made many serious demands on China. One of these is that the great iron works centered at Hanyang be practically handed over to Japan, together with extensive mining concessions. The Chinese Government is taking steps to control all the iron mining of the country, both as a safeguard to prevent the mines being lost to the Chinese and as a precaution to secure their proper exploitation. There are other localities where considerable work has been done in the way of development of iron ore deposits, but while very promising, they have not been on such an extensive scale as around Hanyang.

Last fall, before the effect of the European war became such a factor, the writer was interested in planning some industries for some Chinese which required much iron. In order to make them successful it was necessary to obtain iron of good quality at lower prices than prevailed for imported iron. The present situation, however, makes it necessary to postpone work on these projects. Everything goes that way in China as yet, but facilities have been continually improving under the republic. This field offers wonderful opportunities, and it is a pity that American interests do not send technical experts to investigate the iron situation in China. It will take both money and patience to make this investigation, but the ultimate results would easily compensate for the effort.

Every year there are more and more Chinese students returning from foreign countries, where they have been securing their education, and there is a natural tendency to put them in all of the important positions which are available, often advancing them beyond their real capabilities. There is now quite a waiting list. Foreigners have no right to complain about this, however, but should expect it. These young men should make a very valuable nucleus for a staff, not only on account of their Occidental education, but because they are natives and couple with the outside viewpoint a thorough and comprehending knowledge of the local custom, viewpoints and conditions.

Legal Cause of Accident

BY A. L. H. STREET*

Although an ore car at a mine jumped the track on account of defects in it and the track, the mining company is not liable for injury sustained by an employe in assisting in replacing the car, through carelessness of a co-employee, since such carelessness, and not the defects, must be deemed to have been the direct cause of the accident. In deciding this point in the case of Sabela vs. Newport Mining Co., 151 *Northwestern Reporter* 559, the Michigan Supreme Court qualifies its decision by holding that, if the co-employee had been habitually incompetent and the company was chargeable with notice of the fact, liability against the company could be predicated on its negligence in retaining an employee whose service imperiled other workmen.

*Attorney, St. Paul, Minn.

Correspondence and Discussion

Alcohol and Inefficiency

Analyzing the accident figures quoted in the JOURNAL'S anti-booze editorial of Mar. 6, 1915, it looks as though the average number of accidents at the Anaconda Copper Mining Co. per month is 7.78 per 10,000 shifts; but you state that the September record was 4.21, with the saloons closed half of the month. Then the saving in averages was 3.57, or 44.5 per cent.

The labor unions might preserve their members by a campaign of education, if such figures are an index of general practice. Then, too, the general managers might save some of the stockholders' money which now goes to the hospital by imitating the Czar of Russia in respect to anything interfering with industrial efficiency (which is a kind of war itself).

Berton Braley has put the emotional alongside the efficiency argument. His poem deserves a frame and a place near the Safety-First symbols.

EFFICIENCY SEEKER.

San Francisco, Calif., Apr. 20, 1915.

Fond du Lac Silver Strike

There appeared in the JOURNAL of Apr. 3, 1915, a brief statement that native silver, in quantities to rival Cobalt, had been found at Fond du Lac on Lake Athabasca.

For the past week I have been trying out here to obtain definite confirmation of this, and have been unable to do so. I thought I had better let you know, so that if you wished to mention it you would have the facts as far as they go. A rush into this district would be ill advised, as it is a barren and inhospitable land, and the trip in would, to many who were not sufficiently financed, entail great hardships, and would probably result in death to some.

There is a stretch of 90 miles on the Athabasca River that is dangerous, and which should only be undertaken in large boats with experienced guides. Lake Athabasca is also dangerous for canoes.

However, with regard to the discovery the facts are as follows: Last August two men, Devlin and Dardier, went to Fond du Lac on the east end of Lake Athabasca and in October staked 22 claims. They returned to Athabasca Landing and Edmonton in January.

The claims were staked in a section that for some years had been known to contain a considerable showing of pyrrhotite, which is supposed to carry nickel. Some of these claims were staked over other claims that had been allowed to lapse.

Dardier, who represents English interests (his father is director of foreign affairs for Vickers, Ltd.), brought out with him 400 lb. of samples, which he took to England. He spoke about the possibilities for nickel, and I believe his claims were recorded for that mineral. At any rate, I have been unable to find anyone who has heard him say anything about there being native silver in the district, and no recording was made for native silver.

Devlin is a British Columbia prospector who does not command much respect. On his arrival at Athabasca Landing he gave away several small pieces of native silver, which he said came from Fond du Lac. One of these pieces was sent to be assayed and gave a return of 21,168 oz. per ton. I saw two of the other samples. They were small, about the size of a small bean, and were practically pure native silver. They certainly looked to me as if they came from Cobalt.

I was unable to see Devlin or Dardier, as they were both out of town, but I saw three men, one of them an engineer, who had just returned from staking. Within the last 10 days none of them saw any silver, although of course the snow was on the ground; but they did see plenty of pyrrhotite. I saw their samples, and the ore is a typical pyrrhotite.

I have interviewed a large number of people—prospectors, fur traders, Hudson Bay officials and others who know the district—and can obtain absolutely no definite confirmation of the presence of silver in that section.

The only statement—and that not openly—is from an unreliable prospector who gave away a few minute samples that bear every indication of having come from Cobalt.

You will see that this is hardly sufficient justification for a rush into a district 600 miles away from a railway.

G. C. BATEMAN.

C. P. R.R., en route from Edmonton, Alta.,
Apr. 20, 1915.

Government Publicity Methods

Criticism of Doctor Rittman continues to fill a considerable portion of the oil journals and shows little signs of abating after more than six weeks from the date on which his discoveries were announced to the public. Since much of this criticism is based on an incomplete knowledge of the facts in the case, and is decidedly unjust to Doctor Rittman, I feel that it is only proper that I should make known certain conditions which up to now have apparently not been given proper consideration.

Doctor Rittman and I are rivals in the development of oil-converting processes, but I do not want any advantage in this contest to come to me because of wholly unmerited personal attacks on Rittman, or criticism of him, which is not only unfair, but almost wholly misdirected. In the May and June, 1914, numbers of the *Journal of Industrial and Engineering Chemistry* there will be found a most scholarly and comprehensive article by M. C. Whitaker and W. F. Rittman, in which the basis of Doctor Rittman's work in oil cracking is discussed in a thoroughly scientific spirit. This article should be sufficient to establish the scientific standing of Doctor Rittman, and forces anyone who gives it careful attention to admire the patient work and the brilliant results which were obtained. That Whitaker and Rittman have done most important and valuable work in the cracking

of oils will not be doubted by anyone who takes the time to read the results obtained in these important papers.

That there have been some unfortunate, and probably highly improper, publicity methods used in bringing the Rittman work before the public is undoubted, and my purpose in this statement is to place the blame where it belongs. Up to now it has been laid on both Rittman and on the newspapers, but I believe I can show that in neither case is the criticism justified.

Although Congress has repeatedly insisted that no part of the funds allotted to the Government departments are to be used in press-agent work, it is a matter of common knowledge that several of the Government departments systematically violate these provisions. The Bureau of Mines, in particular, maintains an active publicity department, the work of which can be well seen in the recent Rittman announcements, including the numerous personal-interest stories of Rittman, his muscular development, his football prowess, his helpful wife, etc., etc., *ad nauseam*. No person who knows anything of the scientific work of Rittman can believe for a moment that he has been a willing party to publicity efforts of such a nature.

About a year ago the newspapers of this country were filled with radium press notices. A bill was before Congress carrying an appropriation of $450,000 for radium research by the Bureau of Mines, and apparently the Bureau press agents worked overtime in their efforts to convince the people of this country that radium had almost miracle-working properties. Day after day the newspapers carried press notices of a misleading, if not of a wholly false, character, and no efforts seem to have been spared in this campaign of publicity. In the Associated Sunday magazines, which form the supplement of many Sunday newspapers, on Feb. 22, 1914, there was published an article by Franklin K. Lane, and using his official title as Secretary of the Interior. The opening sentence of this article is as follows:

> When we reflect that the production of every additional half-gram of radium means the saving of a human life a day from the ravages of cancer, no question can remain of our obligation to conserve and make available for use all the radium resources of this country.

At the time this article was written it is not at all certain that a single human life had been saved by radium. As a matter of fact, eminent medical authorities insisted at that time, and still insist, that no case of deep-seated cancer has ever been cured by radium, and that its exploitation as a curative agent for cancer has been due largely, if not wholly, to the efforts of parties who expected to profit by it financially.

Personally, I believe that the numerous misstatements which went through all the American newspapers a year ago were part of a systematic and organized campaign for the purpose of insuring the passage of the Bureau of Mines appropriation bill of $450,000 for radium research. There are strong reasons for believing that the officials of the Bureau of Mines knew at the time that radium had no such curative powers as were being claimed for it.

The many points of similarity between the radium publicity methods and the methods recently used to introduce the Rittman discoveries to the public will probably be noted by anyone who cares to look into the matter. As a matter of fact, I have personally seen some of the press-notice sheets which were handed out to the newspapers of this country in regard to the Rittman publicity. The newspapers published these sheets in practically the identical form in which they came to them, and the cowardly charge that has recently been made, now that it has been found that these publicity efforts were overdone, that these wild and exaggerated statements were due to the "love of sensationalism" of American newspapers is quite as unjust as it is untrue.

WALTER O. SNELLING.

Pittsburgh, Penn., Apr. 20, 1915.

Tailings Disposal in the Mogollon District

In regard to the editorial correspondence appearing in the JOURNAL of Apr. 3, 1915, relative to the discharge of tailings from the mills in the Mogollon district, I inclose herewith a copy of a letter written to the attorney-general of Arizona, in which you will see that the Ernestine company is working in conjunction with all the companies of this district to abate any nuisance that might arise from such practice. The article as published did an injustice to the Ernestine company.

S. J. KIDDER,
General Manager, The Ernestine Mining Co.

Mogollon, N. M., Apr. 12, 1915.

Wiley E. Jones, Attorney-General,
Phœnix, Ariz.

I inclose herewith item taken from the "Engineering and Mining Journal" of Apr. 3, 1915, relative to the discharge of tailings from mills of the Mogollon district, in which the following item occurs:

The Attorney-General of Arizona, who made the notification, states that the Socorro Mining & Milling Co. is making an effort to abate the nuisance, but that the other companies have made no effort to end the trouble, and that unless something is done at once he will take legal action.

As pointed out in my letter to you of Mar. 23, the Ernestine company has from the first coöperated in every way with the other companies of this district in taking steps to abate any nuisance that might arise from the discharge of its tailings. Further, as I pointed out to you in my letter of Mar. 23, up to Mar. 1 the Ernestine company had contributed $2175.75 toward the construction of dams and reservoirs for impounding tailings. I think you will agree that it is manifestly unfair to the Ernestine Mining Co. that a report such as cited above should receive such wide circulation. Such reports are damaging to this company and discriminate in an unfair manner against it. We feel that as the reports have evidently come through your office, it is only reasonable to expect that you will endeavor to correct the erroneous reports that have been circulated to the effect that the Ernestine company was making no effort to abate the nuisance mentioned.

We still have a large crew working on the dams, and with the decrease of flood waters from the various creeks of the district believe that the situation will be handled in a manner satisfactory to the Arizona farmers.

S. J. KIDDER,
General Manager.

Apr. 12, 1915.

Effect of Dry Steam on Molten Matte

Can you or any of the JOURNAL readers tell me what happens when dry steam is run into molten matte? I would like to know, but I do not want to know badly enough to take the chances of trying it. Do you know whether it has been tried? G. A. M.

[On a laboratory scale some reaction happens analogous to

$$FeS + 3\,H_2O = FeO + SO_2 + 6\,H$$

The reaction absorbs a great amount of heat and hence is not self-propagating. It is safe so long as the steam is dry.—EDITOR.]

Editorials

Steel Trade Prospects

The steel trade today is undoubtedly on a firmer basis and with a better outlook for the future than it has had for over a year. We hear a great deal about the capacity of mills, and the current reports seem to give rather low averages, but it must be remembered that capacity has a variable meaning. There is no mill in the country that can operate at 100% of its capacity for any length of time; and 90 to 95% would be a hard standard to maintain. Taking the Pittsburgh, the Valley and the Chicago districts, it may be said that, in general, the steel mills of the country are operating at an average of 70% of capacity, the same as for three or four weeks past. More rolling schedules are made up for a week at a time and fewer are made up from day to day. If orders should continue at the present rate there might be a little slowing down in operations within a few weeks, but with structural business materially increased and with prospects of better railroad buying, as suggested by the budget announced by the Pennsylvania system, there are possibilities of a considerable increase in demand. The labor situation is such that the steel mills, blast furnaces and coke works could hardly operate at more than 85% of capacity; hence if demand should increase by 15%, with the mills now operating at 70%, deliveries would begin to fall behind and buyers would be moved to order for stock, and this would fill the mills up solidly. In recent months the condition as to stocks in the hands of jobbers and manufacturing consumers has been abnormal, as the buyers could depend upon almost immediate shipment from mills even on miscellaneous specifications, while in normal times they should carry stocks equivalent to several weeks of consumption. This condition has helped to induce lighter orders, and consequently an appearance of reduced business.

At the present time there is no doubt that a more substantial demand is developing, which will support the trade when the temporary rush of foreign orders is over. These foreign orders, though much exaggerated in general belief, are not to be despised; but at the best their duration is uncertain, and we cannot rely on their continuance. There is every reason to believe, however, that a solid domestic business is taking the place of the doubtful and hesitating conditions of a year ago and that the lookout for business is far from discouraging.

Employment for Idle Engineers

An experienced Western mining engineer to whom we sent an inquiry not long ago replied by a letter comprising the following paragraphs, which include a bit of interesting personal doings and a suggestion that has some merit:

I left there 18 months ago and have wandered far and spent some money trying to find a mine that I would not be ashamed to ask my friends to develop—but, alas! not yet. My search has taken me to California, and this summer I expect to prospect in Colorado, which brings me to my grand thought. While in New York in January I was struck by the noble efforts of some friends who tried to appear busy. Why not get back to youthful days and go to work as I suggested? I suggest that some of the idle engineers quit trying to split hairs over difficult schemes and see whether engineers can find ore. Of course, I think of Colorado as a good place to try. I know of a dozen places I should like to prospect. This state needs scientific prospectors. The idle engineers need the stimulus of climate and health that can be found out here and elsewhere in the mining sections. Mining properties in Colorado are cheaper than in years, but money rates are high, and it is not coming out West as it should. I suggest that every engineer spend a month this summer prospecting. I believe that a few dozen such men in the hills of Colorado could find something worth while. In any event, they would have a healthful and instructive time.

The idea that first occurs to us is that many engineers who are not well occupied either have given hostages to fortune or lack the financial resources to permit them to go to the mountains for six months of prospecting. For those who are foot-loose our friend's suggestion looks good. What is needed is indeed scientific prospecting, both in the examination of country where no ore has yet been found and in the development of occurrences that are known but inadequately tested. For the latter kind of prospecting some Denver engineers recently united in an enterprise whereof they thought favorably and wherein they put their own money. This was certainly an exhibition of doctors having confidence in themselves. The last word we had of this venture was encouraging. All Colorado hopes, and so do we, that the engineers will find a bonanza.

But for those engineers who are disposed to go prospecting and lack the resources, why should not the good, old-fashioned practice of grub-staking be revived? Grub-staking does not necessarily imply a bearded pard and a burro. Even a graduate of Freiberg might be grub-staked, and out of a bunch of such prospectors somebody might discover something worth while, especially if they should give their attention to things that the scouts for the big exploration companies deem beneath their notice.

A New Attitude toward Leasing

The leaser is attaining to a new dignity. Formerly he was looked upon with no little abhorrence by the manager, and when a mine began to grant any number of leases it was considered at least a tacit admission that the end was in sight. Either suggesting the approaching end of a mine, which is always more or less funereal, or being suggested by it, was equally baneful to the repute of the leaser. Furthermore, he was considered irregular, lazy and generally a poor miner.

Now, however, leasing is being adopted by some of the larger mining companies as an important adjunct to their ordinary, regular operations. The annual report of the Goldfield Consolidated comments on the fact that in the history of every large mine a time comes when a part of its territory can be worked to better advantage by leasers than by any other system. The two principal rea-

sons for this are, first, the lack of efficiency and the expense of supervision for small operations at points distant from the larger stopes, and, second, the close personal attention required in hunting for small bunches of ore which are always overlooked and left behind in the necessarily rapid mining of large orebodies. The territory which a leaser has to cover in his work is very much smaller than that covered by the mine superintendent, or even the shift boss, and therefore the care which he can give to the details of operation and prospecting is much greater and may be quite as intelligent. In the case of the Goldfield Consolidated, leasing along these lines has proved so profitable both to the leaser and to the company that the system is being gradually extended. Care is taken to weed out those leasers who show lack of industry or intelligence, and the company feels that in this manner it is building up an organization which will be of much advantage to it for years to come.

Somewhat similar considerations have led the Ray Consolidated to adopt leasing as part of its regular mining method. In its system of mining, with the many raises from the haulage drifts to the orebody, the ordinary process of stoping leaves pyramidal sections of unbroken ore between the stope-chutes, which the company has found can be removed to best advantage by leasers.

Leasing under such conditions, where the operations are under the general supervision of the management, and where care is taken that only industrious and intelligent men shall secure leases, is quite different from the old-time method of leasing, where only the best ore was gouged out, and the workings were generally left in such shape that they were not only dangerous, but such that a lot of ore was eventually lost to the company. This is now exactly reversed, and the leasers are recovering ore which the mines would not find it profitable to do under the ordinary, everyday method.

The fact that the Goldfield Consolidated, with gold ore which has for a number of years averaged from $30 to the present $11 per ton, and where small bunches of rich ore are found, finds it advantageous to use a leasing system, and that the Ray Consolidated, mining low-grade copper ore, finds it equally to its advantage to use a leasing system eliminates any doubt of the wide range of applicability of the system as far as grade and character of ore are concerned, and suggests some interesting possibilities in large mining operations which heretofore have been generally overlooked.

Gold Mining in the Southeast

It is a matter of some surprise to the people of the southeastern states that a greater degree of interest is not taken in the mining possibilities of the country by the men who are skilled and interested in mining. As a matter of fact there are several obstacles to mining success in that country, none of which, however, are insuperable. The first and principal objection is that mining law does not apply and the prospector has no claim to what he may discover. Of course no one can expect prospecting to be carried on under such conditions. The second obstacle is that wherever a deposit of gold is known to exist its owner, the proprietor of the farmland, has such an exaggerated idea of its importance that he wishes to sell it for enough to put him in the millionaire class at once. Anyone skilled in mining knows that it is not carried on in that way and that development is necessary to prove the value of the land before a price can be set upon it. The third objection is that mining operations have, for the greater part, resulted in catastrophes. Of course these results have been due to foolish management, wild promotions and, in a measure, to the rebellious character of the ores, which not so long ago were not amenable to the cheaper processes and had to be attacked by such expensive methods as chlorination. Modern metallurgy, however, can remove the treatment obstacle and legitimate promotion can cure some of the others. The state of the law which excludes prospectors is apparently the most serious obstacle, but even this could be overcome by the land owners offering prospectors an interest in whatever they might find, or else the drafting of a law which would secure to the prospector that right. We do not advocate any such law at the present time, since sufficient study has not been given to the matter, but we do believe that before mining in the South is going to progress far the prospector must be given a real opportunity and an incentive to do the hunting. The native farmers have neither the skill nor the imagination to replace the Western type of gold prospector.

Lake Iron Ore Prices

At a date somewhat earlier than expected, the sellers and buyers of Lake Superior iron ore have come together and settled on prices for the season. They are the same as last year, $3.75 for Old Range and $3.50 for Mesabi bessemer ores; $3 for Old Range and $2.85 for Mesabi nonbessemer; the base for bessemer ore being 55% iron and under 0.45% phosphorus, and for nonbessemer 51.5% iron. The prices are for ore on dock at Lake Erie ports, and from them must be deducted the railroad freight from the mine to the Lake Superior port and the Lake freight to the lower ports. A Mesabi mine will receive this season $2.40 for bessemer and $1.75 for nonbessemer ore loaded on cars, which does not seem an extravagant sum from which to pay mining and handling costs and value of the ore in the ground, or, what is practically the same thing, the royalties with which most Lake mines are loaded.

The rates, however, apply to only about one-quarter of the Lake ore mined, the other three-quarters being used by the steel companies which own mines and the vessels which carry the ore down. For those companies the price of the ore is its actual cost. In the case of the Steel Corporation this cost is further reduced by the profits it derives from its ore-carrying roads in Minnesota. Even with all the allowances made the mine price of Mesabi ores will not be more than $2 to $2.50 per ton.

The furnace buying ore must add to the price at Lake docks the further cost of loading and hauling from the docks to the furnace yard. For this we have no exact figures, but it will probably average at least $1 per ton. This would bring the cost of the ores in furnace yards up to 8.64 and 8.18c. per unit of iron for bessemer ores, 7.77 and 7.47c. per unit for Old Range and Mesabi nonbessemers respectively. In good years, when business is active and prices high, a fair quantity of Lake ore is sold to furnaces east of the Alleghanies, but at the present time such sales are not probable, as the rail rates would make the cost too high. Nonbessemer ores could not be delivered in the Lehigh or Schuylkill Valley for less than 8c.

per unit; while it is understood that New York and New Jersey ores are being offered in the same district at 6¼ to 6¾c. per unit. It does not seem that much Lake ore will be seen east of Buffalo or Johnstown this year.

The season's prices though low are not by any means the lowest on record. A table of rates for 26 years compiled by the *Iron Trade Review* shows that in 16 years prices have been higher than in 1914; in six years they have been lower, and in three years the same. The highest prices for Old Range bessemer in the 26 years were $5.50 in 1890 and 1900; $5 in 1907 and 1910. The lowest price for that grade was $2.60 in 1897; while $2.75 was touched on the declines in 1894 and 1898. In the past 10 years, or since the steel companies so largely became miners of their own ore, prices have been much steadier than before and the variations less from year to year.

BY THE WAY

From a letter recently received: "This management is quite a little of the old-time secretive-keep-it-dark-hedge-hog type. Articles upon conditions and methods used elsewhere are eagerly devoured, but to give anything to the press is strictly *verboten*." That's not hedge-hog. It's just plain, common hog.

There was something doing in Goldfield last week, according to the following press item:

"Atlanta holed through to the 1400-ft. level of the Grizzly Bear, and the fresh, free air of heaven swept down through the scorching labyrinth of levels to a depth of 1750 ft. from the surface and the workmen filled their lungs with the life-giving oxygen which had never been known in these mephitic caves, where few white men could breathe with any degree of comfort."

The "iron house" at Trenton, N. J., the only one of its kind in the country, will shortly be razed to make room for an addition to the plant of the John E. Thropp's Sons Co., says the *Iron Trade Review*. The house has been occupied for many years by Peter D. Thropp, treasurer of the company. In 1850 Bottom, Tiffany & Co. established an iron foundry on the banks of the Delaware canal. One of the products of the firm was iron fronts for buildings, and Mr. Tiffany decided that a good advertisement would be to build a house entirely of iron. Accordingly he built it. During the civil war the cupola was painted red, white and blue.

A well-known manufacturer of crushing machinery gives it as his opinion that there is but one manufacturer who has ever produced a perfect pulverizing machine, and that is the Divine Inventor. He continues: "I examined one of His machines in 1882. I was impressed with its magnificent output of a million tons per day, crushed from coarse to slimes or silt, according to figures given in a report of the U. S. Geological Survey. I am referring to the great Colorado River. It generates its own power, with no loss of time for repairs, no slipping of tappets, no broken cams, and no dropping of stamp heads—a perfect work from start to finish, and a perfect object-lesson for the inventor. Large irregular rocks are worn into boulders, and from that into cobblestones, and from cobblestones into sand, and from sand into slime, and then delivered to points where the product will do the most good for the human race. The immense Imperial Valley and various other valleys have the finished product from that magnificent pulverizing machine."

Hoover has referred in some of his historical writings to the operation of mines with slave labor in ancient times, which might have permitted the exploitation of ore deposits poorer than anything we work now. Not long ago we happened to read a paper by Prof. S. Zaborowski, which threw some light upon the economics of this subject. Xenophon, seeking a way to enrich Athens without the risks of war, insisted on working the silver mines, and for that labor proposed to buy 10,000 slaves, the purchase of which, he said, would be quickly compensated for by the cheap cost of their labor. "An estimate has been made," says Professor Zaborowski, "and we know that Xenophon was entirely right." A free laborer for 360 days' work cost 540 drachmas ($75). A slave whose maintenance cost two or three oboles (5 to 8c.) per day would accomplish the same amount of labor for 180 drachmas ($26). But there remains the purchase price of 300 drachmas. The interest on that amount at 12%, the rate at that period, represented 36 drachmas ($5) a year. The slave could no doubt work 10 years or more. By redeeming his purchase price in five years one could be guaranteed against all risks of sickness for a number of even feeble slaves. This cost for quick redemption would represent only 60 drachmas per year. And incorporating it in the annual revenue from the work of a slave, all this, interest included, would be only 276 drachmas. Take the round sum of 300 drachmas, and we have the advantage over the cost of a free laborer of 240 drachmas ($33.34) the first year. Thus the purchase price of a slave was reimbursed in 15 months. We might pursue the question and consider whether it were cheaper to buy slaves or to go to war to capture them. War probably was not so costly in the fifth century B. C. as it is in A. D. 1915. However, all figures are relative. Niceas, working the mines of Laurium with 1000 slaves, made 100 talents ($115,000)—an enormous return, a colossal fortune for that period.

Reported in New York

The shares and bonds of the Chile Copper Co. are now on the market, Daniel Guggenheim having sold a block of each to B. N. Baruch and Eugene Meyer, Jr.

The Wall St. tickers on Tuesday printed the yarn that it was reported from Germany that the British government had been buying control of the Amalgamated Copper Co. in order to have its own supply of copper. This was not intended to be taken seriously.

Interests prominent in the management of the porphyry coppers say that those companies have sold their output further ahead than ever before in their history.

The porphyry coppers are now producing at the rate of last July. We have not heard from the other mines, but probably there is no longer any curtailment anywhere.

PERSONALS

V. C. Eason is the new master mechanic at the Union Basin Mines, Arizona.

Edson S. Bastin of the U. S. Geological Survey was recently in the Mineral Park camp, Arizona, inspecting the silver mines.

John Hays Hammond and Harris Hammond have removed their offices to the new Equitable Building, 120 Broadway, New York.

Hamilton & Hansell have removed their offices as consulting engineers to the Whitehall Building, 17 Battery Place, New York.

L. C. Trent is installing an exhibit in the Palace of Mines of the Panama-Pacific Exposition. He expects to be in San Francisco for some time.

Thomas B. Everett recently inspected the property of the Anozira Mines Co. which recently took over the Flores mine in Mohave County, Arizona.

H. L. Taylor, president of the Porcupine Imperial, is at the Porcupine camp in Ontario overseeing the installation of machinery and the reopening of the mine.

L. L. Moore, formerly with the Calumet & Arizona Copper Co. at Bisbee, is now in charge of the Gold Road Mining & Milling Co. properties at Oatman, Arizona.

John D. Ryan gave a dinner in honor of Daniel C. Jackling at Sherry's in New York, Apr. 21, about 150 friends of the host and the guest of honor being present.

F. H. Holbrook, lately engaged with the Imperial Oil Co. at Fort William, Ont., has accepted a position with the London & Pacific Petroleum Co. at Negritos, Peru.

Milton Hoyt, formerly foreman at the Hayden plant of the Ray Consolidated Copper Co., has accepted the superintendency of the Kelvin-Sultana Copper Co.'s plant.

Dr. Willett G. Miller, provincial geologist of Ontario, and A. G. Burrows of the provincial Department of Mines, are making a visit of inspection to Porcupine camp.

Donald Dyrenforth and James E. Dick, graduates of Colorado School of Mines, 1912, are operating mines at White Pine, Colo. They have been in Denver, recently on business.

Frank A. Shirmer of Boston, president of the Utah Apex Mining Co. and a director in the Utah Copper Co., arrived in Salt Lake City. Apr. 19, and is visiting properties in Bingham, Utah.

Fletcner G. Downs, who has been with the Instituto de Geologia y Perforaciones in Uruguay for the last two years, has returned to the United States. His present address is Chatham, Morris Co., N. J.

Hon. G. Howard Ferguson, Ontario Minister of Lands, Forests and Mines, is making his first visit to the mining districts of northern Ontario, accompanied by Premier W. H. Hearst and Hon. Frank Cochrane, Canadian Minister of Railways.

E. L. Larison has resigned his position as superintendent of the acid department of the Ducktown Sulphur, Copper & Iron Co. at Isabella, Tenn., to take charge of the new acid plant of the Anaconda Copper Mining Co., at Anaconda, Montana.

F. L. Culver and a party of directors of the Beaver and Temiskaming mines were in Cobalt, Ont., recently. Some importance is attached to their visit, as probably foreshadowing operations for exploration in the Keewatin below the diabase, in which the two companies may coöperate.

Bradley Stoughton, secretary of the American Institute of Mining Engineers, will leave New York on Apr. 29 to visit various local sections. His itinerary will include Chicago, St. Louis, Butte, Spokane, Seattle, San Francisco, Los Angeles, Bisbee and Denver. While at San Francisco, Mr. Stoughton will serve on the jury of awards in the department of mines and metallurgy. He will return to New York early in June.

Benjamin Magnus, who has been general manager of the Mount Morgan Gold Mining Co., of Queensland, for several years, has resigned that position, and also his position as consulting engineer to the Electrolytic Refining Co. of Port Kembla. He intends to leave Australia about June 15 and will visit Java, Singapore, China and Japan, expecting to arrive in San Francisco about the middle of October and in New York early in November. In the meanwhile mail matter for Mr. Magnus may be addressed to him in care of the "Engineering & Mining Journal."

S. Le Fevre, who has been with Witherbee, Sherman & Co. for the past nine years, as assistant general manager, general manager, and general mining engineer, announces that his services will be available, after May 1, as consulting mining engineer, with permanent address at Forest Glen, Ulster County, N. Y. Mr. Le Fevre has had a very wide experience in mining, management, and construction of plants, as well as 17 years practical work in the magnetic concentration of ores, and the designing of mills. The extensive plant of Witherbee, Sherman & Co. at Mineville, N. Y., has been largely developed during the period of his work there.

Adelbert I. Weiland, of Fowler, the new state engineer of Colorado appointed by Gov. Carlson to succeed John E. Field, has already taken possession of his office. Mr. Field will be retained as the engineering member of the state land board. The governor has also appointed Fred Carroll, manager of the Atlas Mining & Milling Co., Ouray, to succeed Thomas R. Henahan as state commissioner of mines. Because of Mr. Henahan's appreciated activities in the interests of the Colorado Metal Miners' Association, numerous influential members of that organization are urging his appointment as member of the state public utilities commission to have special function in mining affairs but, contrary to press announcements, his candidacy has not been indorsed by the association officially.

SOCIETIES

University of Utah—By an act of the Legislature of the State of Utah, which became effective July 1, 1913, there was established in connection with the State School of Mines, a department of the University of Utah, a metallurgical Research Department. The particular purposes for which this department was established are the "finding of ways and methods of profitably treating low-grade ores, of securing a higher percentage of extraction of metals from their ores, of obtaining other information that shall have for its object the benefit of the mining industry and the utilization and conservation of the mineral resources of the state, and to publish and distribute bulletins and articles relating to the department and its work." By an agreement with the United States Bureau of Mines, the work of this department is under the direction of metallurgists of the Bureau, assigned to duty at the University and Salt Lake City. Since January, 1914, D. A. Lyon, metallurgist, has been in charge of the work assisted by other members of the metallurgical staff of the Bureau, assigned to duty of Salt Lake City and with headquarters at the University. Since that time, O. C. Ralston, assistant metallurgist for the Bureau, and J. F. Cullen, chemist, have also been assigned to the work. In connection with this new department there have been established five research fellowships in metallurgy, each having an annual value of $720. These fellowships are open to college graduates who have had a good training in chemistry and metallurgy and applications for them will be received up to May 15th, 1915. Applicants should send a copy of their records from the registrar's office of the college where they have, or will be, graduated and the names and addresses of at least three references who know their character, ability and attainments.

As was to be expected the first year was largely devoted to making a preliminary survey of the state for the purpose of determining the nature and extent of the low-grade orebodies of the state. After this a study was made of the literature and of the processes which it was thought it might be possible to apply to the solution of the problems with which the Department has to deal. At this time these problems are as follows:

1. A study of the flotation processes in order to determine their applicability to the treatment of ores which are not at the present time being treated by such processes.
2. The chloridizing roasting and leaching of ores.
3. The recovery of precious metals in the presence of interfering elements, such as copper.
4. The separation of lead and zinc ores and the recovery and conservation of the terrific amount of zinc that is lost in mining, milling and smelting operations.

Holders of these fellowships will be subject to the rules governing employees of the National Bureau of Mines and will report for duty July 1, 1915. They must also register as students in the University of Utah and become candidates for the degree of Master of Science in Metallurgy (unless this or an equivalent degree has been previously earned). Their class work will be directed by the heads of the departments of instruction and their laboratory work, as previously stated, by metallurgists of the Bureau of Mines. Fellows are appointed for one year, but the appointment may be renewed. Address applications to Jos. F. Merrill, Director of the Utah State School of Mines, Salt Lake City.

Editorial Correspondence

DENVER—Apr. 22

Tungsten-Ore Purchasers in this state, principally in Boulder County, announce a 20% advance in the price of 60% WO_3 concentrate. The recent price for this grade of concentrate has been $5.80 per ton; it is now $7. The increase is accounted for by demands for the metal in making projectiles and in tool steel for manufacturing weapons of warfare.

Leadville Is Rejoicing over prospects for another prosperous epoch in its history. This district has played numerous rôles as a metal producer, beginning with gold placering in California gulch. Then it became a rich lead camp, following this very quickly with fame for the silver found associated with the lead. It then produced oxides of iron and manganese, suitable as fluxes in smelting. Twenty years ago, interest centered in remarkable discoveries of gold ore. A few years ago, much of the country rock in the old lead-silver mines was identified as silicate and carbonate of zinc and the mining of zinc became popular. Water has ever been a serious obstacle to Leadville mining, many of the downtown properties having closed down because of this handicap. There are topographic possibilities of drainage to a considerable depth by a long adit but money and nerve have been lacking to finance such a project. Two years ago, ex-Gov. Jesse F. McDonald, who made his money in these mines, began organizing many diverse property interests into a drainage project. The Downtown Mines Pumping Co. now controls options, leases or deeds to a large acreage of mining property which is to be unwatered by one central pumping plant at the shaft of the Penrose mine. Machinery had been ordered from Switzerland just previous to the outbreak of the European war but orders were necessarily canceled. Contracts were then placed with the Providence Engineering Works, Providence, R. I., and pumps should have been delivered two months ago. However, ordinary manufacturing delays occurred so that the pumps only reached Leadville Sunday, Apr. 4. The elation was so general that a local brass band gave an open-air concert on Harrison Ave. Water was discharged by the new machinery for the first time Apr. 19. Most of the territory to be drained by this project has been idle since 1907. One of the duplicate pumps began pumping at the rate of 2200 gal. per minute against a head of 240 ft. Each unit is guaranteed to lift 1500 gal. per minute against a head of 430 ft. Mining operations will probably not begin in the old workings before the early part of next winter.

Purchase of Ore by Cripple Creek Assayers has been permanently enjoined by Judge Little of the district court. A year ago, two large mining companies secured an injunction restraining 27 assayers of the district from purchasing ore. This injunction was appealed to the Supreme Court but supersedeas was denied, thus making possible this recent ruling that aims to prevent highgrading.

Cripple Creek is Active and is drawing back many of its early miners who, some years ago, left for new fields in various parts of the country. Scarcely a mining property within the known mineralized area of the district is idle. Old dormant companies are waking up to the potentialities of their possessions, new companies are being incorporated, lessees are securing every available block of desirable ground, new plants of machinery are being installed and there is every prospect that 1915 will prove the banner year in gold production from this restricted area. Every large company is exploring to new depths and with marked success, while associated operators of the district are again pushing the Roosevelt tunnel to relieve the drainage troubles of the deeper mines. El Paso company has adopted a new policy providing greater attraction to leasers. It has been decided that the company can make most money mining in old workings by granting privileges to practical miners, so, in furtherance of this idea, an unusually low scale of royalties has been established whereby very low-grade ore may hereafter be removed at profit to leasers. This assures a large tonnage from this property in near future. The Golden Cycle stockholders of record during first quarter of this year have received magnificent returns on their investments. The January dividend was 15%, while the regular February and March dividends were each 5%. Then, during March, upon the sale of the Golden Cycle mine to the Vindicator company, there was distributed an extra dividend amounting to 190% thus making the profits to stockholders during three months 215%; representing a distribution of $3,225,000. While it might seem that disposal of the mining property would terminate dividends, this view is upset by statements of officials that the reorganized company will continue dividends at the rate of at least 2% per month.

SALT LAKE CITY—Apr. 22

Many New Mining Companies have been incorporated as a result of the increased activity in the Alta and Big Cottonwood districts, and 13 new issues have been listed on the Salt Lake Stock & Mining Exchange since the first of the year, this exceeding all recent records. Various claims have been taken under option. The interest which is being shown in these camps should have the effect of bringing about much development work, with the probable opening of new orebodies.

GOLDFIELD—Apr. 21

The Booth-Jumbo Ex Apex Litigation has been compromised. All of the Booth work being done to afford data to the experts for proof of their apex contention has been discontinued and the geologists who were retained have left camp. The basis of the settlement has not been officially stated, but it is reported on apparently good authority that the Booth apex contention is conceded, that a vertical sideline agreement will be consummated and that the Jumbo Ex will increase its capitalization to 2,000,000 shares, give the Booth company 300,000, and place 450,000 shares in the Jumbo-Ex treasury. The Jumbo company announces a call for a special stockholders' meeting to be held at Phoenix, Ariz., on May 20, to ratify the Booth agreement. The Booth sued the Jumbo Ex for an accounting for $900,000 worth of ore, from the rich Jumbo ore shoot, to which the Booth claimed the apex.

SEATTLE—Apr. 22

Despite the Early Break-up of ice in the Yukon River, navigation on that stream will not open until June 1. Officers of the White Pass & Yukon company, operating steamboats from the headwaters at White Horse to the mouth of the river at St. Michael, say the low stage of the water along the 50-mile stretch between White Horse and Lake Labarge make it inadvisable to start the river boats ahead of the usual time.

An Impending Stampede of labor to Seward to find employment on the new railroad to be built by the Government has called forth warning from official sources. No construction work is going on at present, nor is there any possibility of work being started for several weeks. Most of the work will be let out to station men, who will do their own work and who will require a little capital to begin with. Not more than a few hundred men will be needed this season, and it is probable there are sufficient numbers there now. In this column in the issue of Apr. 17 comment was made on the number of unemployed men in Alaska even before the temptation of this new piece of work set a tide of unemployed from this country in that direction. No man should go to Alaska without money enough to return to the States in case he does not find work. At present the opportunities for employment in Alaska are very few.

The Fairbanks District is almost as much stirred up over the announcement of the selection of the tidewater terminal for the Government railroad as is that portion of Alaska adjacent to the Matanuska coal fields, Seward, and Sheep Creek, even though, according to Washington reports, the road will not be built to the interior for possibly two or three years yet. The area of the known gold-bearing gravel deposits in the Fairbanks district consists of approximately 150,350,000 bedrock feet, of which about one-third, or 50,000,000 bedrock feet, has been mined, producing $64,200,000, or $1.28 per bedrock foot for the entire area worked, which includes the richest portions of the pay channels. The unworked ground could not be made to average more than 60c. per ft., which, under the existing conditions, would permit of profitable working only in exceptional cases, where means other than drifting can be employed or where rich pay streaks are uncovered. There are probably 50,000,000 ft. of ground in Fish Creek and trib-

utary creeks, which will yield, according to the best information, an average of 60c. or more. The advent of the Government railroad will be a large factor in reducing the cost of operations to a basis allowing the working of these low-grade deposits, as coal of a good grade can then be delivered at the plant for a cost not to exceed $7.50 per ton. This alone, it is estimated, will cut the cost of working from 7 to 8c. per ft., as the average plant under present conditions pays $25 for an amount of fuel equivalent to one ton of coal which will hoist and thaw an average of 250 bedrock feet. The railroad will further reduce the cost of labor and supplies so as to permit the operation of 60c. gravel at a profit. Improved methods of mining will make ground of a much lower value than this available for working. With the low-grade ground opened up the output from the district will be enormously increased, since scarcely one-half of the placer gold of the district has been mined. Those who know the Fairbanks district well are confident that the coming of the railroad will reduce costs to such an extent as to permit the operation of the low-grade ground at a profit. It now costs from 28 to 36c. per bedrock foot to operate by the open-cut method in the district.

In the Tolovana District new discoveries of pay are being made with gratifying frequency. The latest discoveries reported are on No. 3 below Discovery, bench claim, and on No. 12 above Discovery. Lynch, Stone & Verdi, who recently found good pay on Olive Creek, have taken advantage of an unexpected cold snap to freight in a complete mining outfit, including two 16-hp. boilers, a 10-hp. hoist, a 12-hp. pumping engine, a 6-in. centrifugal pump, cables, bucket, points, etc., and will work as many men as possible this summer. J. C. Kinney is also taking in a 16-hp. boiler but does not expect to hoist much pay. It is now claimed that shallow-draft boats can ascend the Tolovana at high water to the mouth of Livengood Creek, and an attempt will be made after the breakup to put machinery on some of the claims where pay has been found.

KINGMAN, ARIZ.—Apr. 22

The Greatest Mining Boom in its history is being entered upon by Mohave County and is founded upon ore discoveries of sufficient importance to encourage legitimate mine exploitation in preference to stock manipulation. Focus of the present activity is at Oatman, the site of the famous Tom Reed mine, which has produced about $6,000,000 in the last six or seven years, but the scope of operations is gradually extending over the entire county. The Tom Reed, with the latest find of the ore chute on the 1000-ft. level, is responsible for proving that large orebodies exist in the Oatman district. The recent discoveries of the United Eastern show that rich ore is of wider occurrence than might be suspected from the Tom Reed workings and are immediately responsible for the impetus which has been given to mining development in the district. Long and McIver deserve praise for their plan of development; work having been based upon a careful study of the geology of the district and no ore encountered until the shaft had reached a depth of 100 ft. and the first strike of importance at 300 ft. The work was carried on rapidly and economically and a record for speed in shaft sinking established for the district and their example should have an influence on the standard of efficiency and economy of mining operations throughout the district.

In the Cerbat Range and Chloride District, the prevailing high price of zinc is the chief factor in stimulating activity, the Golconda mine, the property of the Union Basin company, being the largest producer. Exploitation of several other properties for zinc ore is under way. Kingman, the county seat, is profiting greatly by the mining activity. It was expected that the recent closing of the saloons on account of State Prohibition would be a severe, although temporary, blow to the fortunes of the town but the present mining boom has far more than offset the anticipated loss of revenue. A Chamber of Commerce has been organized and is working in conjunction with the newly organized Oatman Gold Road Association which was formed for the purpose of advertising the Oatman district. Any inquiries sent to the Kingman Chamber of Commerce will be referred to the proper committee and answered in an intelligent and conservative manner. The Chamber of Commerce has just considered the improvement of the road between Kingman and the Oatman Gold Road District, and has made a strong recommendation to the Board of Supervisors that an election be called to vote bonds in the amount of $100,000. At the present time there are grades on this road as high as 20 and 25 per cent. It is considered possible to cut these grades to 6 or 8 per cent. This work will probably entail an expenditure of $50,000 for six or eight miles of road. The boom has come at what may be considered the psychological moment on account of the volume of tourist travel expected to traverse the county this year en route to and from the two California fairs.

DOUGLAS, ARIZ.—Apr. 18

The Railroad between Cananea and Naco is again open and has been in operation for about three weeks but no ore has been taken out and only supplies have been allowed to go to Cananea. About 400 men are now working around Cananea keeping the buildings and smeltery in repair and keeping the ground "caught up" in the mine. There is very little development work being done in Cananea and nothing being done outside. A large amount of supplies have been sent in and at the present time there are plenty of provisions of all kinds but the prices are so high the poorer class of Mexicans cannot buy very much as they have no money and it is next to impossible for them to live on the ordinary wages. Mexican paper pesos are worth 7c. each U. S. currency. The peso at the present time is made by all the different factions and there are many kinds both Villista and Carranzista; each side has issued several different kinds and none is good with the other side.

The Railroad between Agua Prieta and Nacozari is again open, both places being in the hands of the Carranza factions. The first train in six weeks went to Nacozari on Apr. 8 and took in three cars of flour besides much other provisions. Flour has been selling in Nacozari for $7 per 100 lb., and it has been almost impossible to buy it at that price because there was none to be had. There were no frijoles, the staff of life of the Mexicans, in the country. The train arrived in Agua Prieta on the 10th bringing 146 cars of concentrates from the Moctezuma Copper Co.

DULUTH—Apr. 24

Navigation is Now Open on the Great Lakes and a number of freighters have already left Duluth for lower lake ports. A large fleet loaded with grain left on Apr. 17, and ore carriers will start moving this week. There is now considerable ore on the docks and a number of trains are arriving from the Mesabi daily. On Apr. 22 the Duluth, Missabe & Northern Ry. resumed operations over its double-track system. The ore season is opening up far better on the Mesabi than it did a year ago and it is believed by many mining men that the year will be a better one for the iron-ore trade.

Conditions on the Minnesota Ranges are far better than they were a year ago this time and it looks as though the tonnage would exceed that of 1914. An official of the Duluth, Missabe & Northern road stated this week that his road had contracts already to move 12,000,000 tons of iron ore to the docks. The Duluth & Iron Range road is also busy and will move a considerable tonnage from the Vermilion. The Great Northern and Soo lines are also preparing for an active season. The first ore buying of the year started in Cleveland this week, when 750,000 tons were contracted for. The 1914 prices still prevail. Conditions look far better than they did two weeks ago.

TORONTO—Apr. 24

The Electric Power Shortage difficulty at Cobalt and Porcupine has been overcome for the time being; the situation is not regarded as satisfactory, as with the present limited sources of supply and the steadily increasing demand the trouble is likely to recur at any time. The operators are looking to the Provincial Hydro-Electric Commission for relief. On Apr. 22 the Cobalt Town Council passed a unanimous resolution requesting the commisison to send its engineers to investigate the power situation and the rates charged by the company.

STOCKHOLM—Mar. 30

A New Company, The Norske Spitzbergen Co., in which Vavasour Earle, of London, is a director, was incorporated in Christiania on Jan. 9. The capital is 455,000 kroner ($121,940), of which 145,000 kroner ($38,860) is cash. The object of the flotation is the exploitation of several mineral deposits on the island. The international conference, which at the outbreak of the war was postponed till Feb. 1 of this year, has not resumed its sittings.

The Helsingborg Refinery in Sweden, which treats the purple ore from the Sulitjelma mines in Norway, has since 1903 turned out 29,520 tons of refined copper, 4178 tons of "cement" copper, 5321 kg. of silver, 12.21 kg. of gold, 447,515 tons of briquetted iron ore and 114,294 tons of ore unbriquetted. This year the output will be about 4500 tons of refined copper, 800 kg. of silver, 1.4 kg. of gold, 65,000 tons of briquetted iron ore, and 25,000 tons of unbriquetted ore.

The Swedish Nickel Mines of Aedelfors and Kleva are again to be taken up and a number of the old slag heaps resmelted. A concentrator and smeltery are being erected, together with a power station. Formerly the sulphur content of the ores was roasted off, instead of using it as fuel, as it is now intended to do. There is a lively foreign inquiry at present for Scandinavian nickel.

The Mining News

ALASKA

ALASKA GOLD (Juneau)—At mill results from first month's operations, applying to treatment of about 40,000 tons, show recoveries in excess of $1.50 per ton from ore containing about $1.85 per ton in gold and silver. Second section of mill will be in operation about June 1, and third section about month later. Entire mill, with addition of little more machinery, will have ultimate capacity of 12,000 tons per day. Additional water-power development is contemplated to take care of this increased tonnage.

ALABAMA

TENNESSEE COAL IRON & RAILROAD CO.—(Birmingham)—Announcement by president that construction will begin at once on new benzol plant to be erected by company at Fairfield, where wire mill of American Steel & Wire Co. is located. The plant will have a capacity to recover from byproduct gases 15,000 gal. of benzol every 24 hours.

ARIZONA

Gila County

INTERNATIONAL SMELTING (Globe)—New smeltery nearing completion to handle high-grade concentrate from Miami and Inspiration mills, will have unique distinction of turning out more copper than any other smeltery in state, although not treating largest tonnage. This on account of fact that plant will treat concentrates which are of high grade instead of ore. Plant contains no startling innovations in construction although including all up-to-date improvements in smeltery building.

SUPERIOR & BOSTON (Globe)—Smelting contract for three years has been closed with American Smelting and Refining Co.

Maricopa County

PITTSBURGH TUNGSTEN (Cave Creek)—Shipment of several tons of tungsten ore has been made to Denver from property of company seven miles north of here.

ORO FINO (Phœnix)—Mine in Winnifred district 18 miles north of here is making preparations to ship some high-grade ore to smeltery. Lower grade ore will be milled at later date.

VULTURE (Wickenburg)—Continues shipment of concentrates. More than 200 men at present employed in mine and mill. Sinking in new shaft has recently opened up some good ore.

Mohave County

UNION BASIN (Golconda)—Installation of new equipment including hoist of large capacity, compressor and engine completed. Shipments resumed on larger scale.

COPPER MOUNTAIN (Chloride)—Copper mine in Grand Gulch district recently leased and regular shipments via Grand Gulch have been begun.

NEVADA-ARIZONA (Kingman)—Recently shipped its second bar of bullion. Mill giving excellent results.

BRANNOCK (Union Pass)—Mill at Meyers Well put in condition and will resume operations early in May.

GOLD REED (Oatman)—Mayflower shaft has been unwatered and will be sunk an additional 500 ft. as soon as new hoist is installed.

TENNESSEE (Chloride)—Mine shipping 200 tons daily to the mill at Needles. Champion mine also ships a car.

UNITED WESTERN (Oatman)—Shaft to be straightened and sunk an additional 400 ft. New equipment to be installed.

GOLD ORE (Oatman)—Shaft is to be sunk an additional 200 ft. and crosscut be made to vein which left shaft at 180-ft.

Pima County

YUMA (Tucson)—Col. Epes Randolf and associates have taken over old Yuma mine, 14 miles west of Tucson. Work is under direction of Courtenay DeKalb. Gold is principal metal though ores carry vanadium and molybdenum.

CAVILLO (Tucson)—New working shaft being sunk by Frank and Warren Allison on this copper property.

LAS FLORES (Tucson)—Small shipments being made to Douglas.

LAS GUIJAS (Tucson)—Charles Bent has completed concentrating plant at his tungsten property.

TORTILLITA (Tucson)—Main shaft is to be sunk by contract. New compressor, drills and sinking pump recently installed. F. B. Work, of Tucson, has contract. Nott E. Guild is manager.

Pinal County

CONSTRUCTION OF SUPERIOR & ARIZONA R.R. which will be finished about May 1 has stimulated mining development in Superior district. Work has been started on number of claims and prospects are favorable for large ore output shortly after road is placed in operation.

Yavapai County

UNITED VERDE EXTENSION (Jerome)—From drift on 1200 level, 10 tons of ore, averaging 22% copper from vein 7 to 19½ ft. wide, is being shipped to smeltery daily.

NELSON (Crown King)—If electro-chemical process of treating ores proves successful at Mayer plant now under construction, similar kind of plant will be built immediately by this company. George P. Harrington, general manager, is quoted for above statement.

BUFFALO-ARIZONA (Hot Springs Junction)—Fire of unknown origin destroyed mill and several other buildings. Plant built eight years ago has been idle for long time. No insurance carried. Will rebuild.

GOLDEN IDOL (Cherry Creek)—Some improvements have been made in mill and after test run it was decided to resume operations. Owned by Loper & Guttry.

Yuma County

GEORGE W. NORTON (Yuma)—Is developing large deposit of baryte few miles east of Yuma. Plans to ship 200 tons per week to Los Angeles.

CALIFORNIA

Calaveras County

ROYAL GOLD (Hodson)—Has completed two storage bins on 500 level, total capacity 1000 tons. Mill finished with exception of laying down balance of plates.

Inyo County

MINNIETTA (Johannesburg)—Several hundred tons of ore on dump ready for shipment; will be hauled by auto truck to Trona and shipped by Trona Railroad to Southern Pacific at Searles. Ore reported to assay about 50% zinc, some lead and silver.

CERRO GORDO (Keeler)—Permission has been granted by state to issue stock should it become necessary. Mine has within past year been brought again into productive class.

Kern County

BUTTE (Randsburg)—Good ore reported in the drift on 250 level; 40 tons extracted and extensive operation contemplated.

STANFORD (Randsburg)—Good returns reported from placer operation. Pay gravel contains gold and tungsten. A jig has been installed by Buys & Truman. The Varney property has same installation, which is also successful.

Madera County

ENTERPRISE (Grubgulch)—Recent extraction of several thousand dollars from a 30-ft. ledge warrants renewed development. The mine is equipped with 10-stamp mill; 5 stamps are dropping. Power is furnished by 70-hp. waterwheel for mine and mill. L. R. Johnson is manager.

Shasta County

PITTSBURG MT. SHASTA GOLD (Redding)—Will erect plant to cost $100,000 to handle copper ore at its mine. T. V. Scott is Secretary.

UNCLE SAM (Kennett)—Ore extracted by leasers, being crushed in 10-stamp mill which recently went into commission after being idle for two years.

Nevada County

GIUSEPPI DAMIANO VS. BIRCHVILLE MINING CO.—Jury awarded plaintiff $12,000 for injuries sustained in defendant mine in 1913. Suit was for $25,000.

Siskiyou County

HYDRAULIC-MINING COMPANIES endeavoring to purchase ground occupied by Roman Catholic Cemetery at Sawyers Bar. Estimated that the cemetery ground contains $40,000 worth of gold. Mining has been conducted on all sides and right up to cemetery lines. Cemetery was laid out in 1857 and church officials declare that they will not take up bodies and will not sell at any price.

ISABELLA COPPER (Etna Mills)—Work resumed. Tunnel will be advanced 100 ft.

Tuolumne County

McCORMICK (Jacksonville)—Tunnel will be advanced 1200 ft. farther to the west end line of property which produced large amount of gold at a depth of 40 ft. several years ago. At the 2200-ft. point the floor of the tunnel will have vertical depth of 1100 ft. below surface. Andrew McCormick, of Stockton, is owner.

COLORADO

Boulder County

POTATO PATCH (Boulder)—Horry & Co. have contract to drive 400 ft. of adit expected to tap Livingston shoot from which $200,000 in gold was mined in workings above. Kitto & Co. have contract for drifting in adit No. 4 to exploit large body of low-grade gold ore.

Clear Creek County

SANTIAGO (Georgetown)—Maintains small shipments of complex ore averaging about $60 per ton.

IDAHO BRIDE (Idaho Springs)—Remodeled mill operating on steady supply of custom ores, handling about 35 tons per day. Bids being received for contracts to sink Bride shaft and to extend levels.

WALDORF (Georgetown)—Imperial Mining Co. developing Commonwealth vein 3 ft. thick, almost solid sulphides. Twen-

ty-ton test lot ran 1.53 oz. Au, 67.1 oz. Ag, 12.8% Cu, and 8.1% Pb. Shortage of water prevents milling of considerable ore that might be produced by numerous leases.

Gilpin County

INGALLS (Central City)—Pool of local business men is developing this property and has installed small hoisting plant.

IRON CITY MILL (Black Hawk)—Capacity will be increased from 75 to 100 tons per day by addition of more concentrating tables. This custom mill does concentration only.

QUARTZ HILL RADIUM & GOLD MINES CO. is title of new incorporation, controlled by Eastern people, promoted by Charles Gage of Central City. Old well-known mines held by this company are Egyptian, Kent County and Rails County, all of which have good records of production.

GILPIN-EUREKA (Central City)—John Jenkins, who acquired this mine several months ago, has property in producing shape and is treating about 20 tons daily in his stamp mill at mine.

OLD TOWN (Russell Gulch)—From foot of 100-ft. winze sunk below the 1200 level, Roberts & Hutchins, leasers, have drifted 70 ft. in shoot of rich ore, 12 ft. thick. The 1000 level is being pushed toward this shoot by Bray & Co., leasers. Development being done also on 1400 and 1500 levels.

Lake County

HAYDEN (Leadville)—Leasers Harris & Madsen ship 20 tons carbonate ore per day to Iola, Kan., smelting plants. Ore averages 22% zinc.

IRON-SILVER (Leadville)—During 1914, mine produced 41,812 tons ore that was sorted down to 37,979 tons yielding $10.48 per ton. Leasers mined 14,512 tons on which average return per ton was $4.25, with royalty averaging 45c. per ton. Year's production was 9689 tons less than in 1913, but net earnings showed increase of $50,702, due to better markets for metals.

Teller County

STRATTON'S INDEPENDENCE (Victor)—Supt. Eric Johnson announces discovery of large shoot of high-grade ore in new workings that extend further south than any previous workings. This find is in the Washington claim, in granite, a distance of approximately 1000 ft. from the wall of the Cripple Creek crater.

VINDICATOR (Independence)—Large compressor has been removed from Hull City shaft plant and erected at No. 2 Vindicator shaft. Shatz lease outputs heavy tonnage from block of ground between 600 and 800 levels. Beard lease has struck 20 ft. of good ore that was left alongside workings by former operators. Bruner lease on 1100 level has 3 ft. of high-grade ore.

Ouray County

ATLAS M. & M. (Ouray)—Treating ore containing principally copper glance by flotation method, said to be first commercial flotation plant in this country, is making recovery of about 90%. Manager Carroll is quoted as saying that a recovery of 95% on San Juan ores is possible.

KANSAS

O. W. SPARKS (Galena)—Will erect two new concentrating plants. Mr. Sparks is associated with Dick Turpin in one mill proposition and company will be known as Dick Turpin Mining Co.; mill will be located on Riseling ground; mines are well developed on this tract of land with good mines all around them. Other mill will be at Tom Cat Mines on Taylor and Glover land near Chitwood. Mr. Sparks has drilled 25 holes and encountered ore in all of them runing from 15 to 25 ft. thick and assaying from 15 to 25% zinc. Mills will be modern in every respect and will have daily capacity of 300 tons each.

R. E. P. (Galena)—Is installing large centrifugal pump on Parks city lots east of Main St. At depth of 110 ft. water came in so strong that it required heavier machinery to sink further; is company's intention to sink to 175 ft., at which they expect to encounter good run of zinc ore that has been traced on this ground at about this depth.

OLD TROY MILL (Galena)—Tailing company has taken lease on mill and tailings and will re-run them. Tailings have already been retreated once since they were piled by original company.

PEACOCK (Galena)—Have their ground drained on the Illinois Lead & Zinc land southwest of Galena and are taking out good ore, which they are running through their mill steadily. They expect to lease part of ground to miners and mill dirt on shares.

MICHIGAN

Copper

HANCOCK CONSOLIDATED (Hancock)—Sending about 600 to 800 tons of rock weekly to Franklin mill, where one head is devoted to Hancock rock. Has 14 drills working.

SOUTH LAKE (Houghton)—Will make no mill test for some time. Is obtaining splendid results in its exploration and development of four lodes opened.

NORTH LAKE (Houghton)—Has driven its crosscut 800 ft. to reach the Evergreen series of lodes.

MASS (Mass)—Has opened lode of Evergreen series, believed to be one of those tapped by South Lake, and good showing of commercial ore is being developed. All four lodes are believed to pass through Adventure property, which lies between Mass and South Lake. Mass is steadily increasing output.

NORTH KEARSARGE (Kearsarge)—No. 3 shaft will resume during May, or as soon as boiler plant can be put into shape. Two of boilers have been repaired and replaced and other three will be in place within two weeks. A permanent stack will begin building this week. The plant was put out of commission by an explosion of one boiler in January.

BOHEMIA (Houghton)—Resumption of operations will likely produce some interesting results. Diamond drilling will be conducted this summer, justified by cores already secured and by results obtained in development upon other properties in immediate vicinity. Bohemia has for 3000 ft., on strike the Mayflower-Baltic amygdaloid lode as well as felsite beds which Indiana cores and shaft work developed. Commercial rock was disclosed by some cores.

CALUMET & HECLA (Calumet)—Has refused offer of $700,000 for site of its old smeltery at Buffalo, N. Y. This is 20 times the cost. Its location at entrance to international bridge, with dockage for canal and lake on either side, make it highly desirable for railroad yards or grain elevator.

ARCADIAN (Houghton)—Arcadian lode has widened to 16 ft. and improves in character as it approaches New Baltic.

ISLE ROYALE (Houghton)—Can resume shipping from No. 1 shaft on Grand Portage lode within few days. Reconstruction work on surface and in shaft proper is completed, except some work in getting tramway and cars in shaft dumps in proper shape. Rock is richer than any Isle Royale has ever produced before and comes mostly from Nos. 2, 4, 5 and 6 shafts.

MASS CONS. (Greenland)—Mass is shipping at present 1200 tons of copper rock daily. This does not include mass stuff that goes direct to smeltery.

Iron

NEWPORT MINING (Ironwood)—New American record for shaft sinking made in March at new Newport shaft being put down 300 ft. away from present shaft. Shaft is vertical, 14x24 ft., and was put down 190 ft. in 31 days. Rock broken and hoisted in the 31 days was 63,840 cu.ft. Shaft will have five compartments, three skip roads, one cage road and one compartment for pipes and ladders. Will be sunk below 2000 level. Small hammer drills are used in sinking.

MINNESOTA

Cuyuna Range

ROWE (Riverton)—Two steam shovels and one hydraulic unit working. Preliminary work on concentrator is progressing. This will be Cuyuna Range's first concentrating plant.

BRAINERD-CUYUNA (Brainerd)—Shaft down 140 ft. will be bottomed at 160 ft. Ore can be shipped this season if market is found. Northern Pacific gets traffic.

DULUTH-BRAINERD (Manganese)—W. B. Cook appointed receiver for this company Apr. 15. Company has manganiferous iron deposit of possible value, shaft, and crude surface plant. Stock company dominated, until recently, by Locker-Donahue interests.

HILL CREST (Ironton)—Actual stripping operations now under way with one hydraulic unit, electrically operated, sluicing overburden. Twenty-five men employed.

Mesabi Range

COMMODORE (Virginia)—Operations started Apr. 19 with one shovel in ore. New headframe being constructed at mine and other minor improvements made.

ELBA (McKinley)—Owing to indications of caving around old shaft, necessary to move surface plant distance of 600 ft. As operators planned to begin producing Apr. 26 indications of caving were exceedingly embarrassing and record-breaking "moving" was conducted. At new location has been erected one of the highest stacks on Mesabi; is equipped with Murphy economizer.

HAWKINS (Nashwauk)—Addition to be built to present washing plant. Steel has been ordered.

QUINN-HARRISON (Nashwauk) — Steel for new concentrator is being put in place. Hoped to have plant ready for use by June 1. One shovel is stripping in pit, dirt being used for dam to hold tailings from concentrator. Mining will start as soon as mill is ready.

CROSBY (Nashwauk)—Is to have concentrator. Steel has been ordered. Plant will be located one mile north of mine.

NEVADA

Clark County

YELLOW PINE (Goodsprings)—Mill resumed operation in March, and has been running continuously since. Monthly production 200 tons of lead concentrate, 1500 tons of zinc concentrate and 300 tons of crude zinc carbonate ore maintained. Sinking the two-compartment shaft discontinued temporarily. Crosscut being driven from the 800 level to intersect in vein.

BOSS (Goodsprings)—Platinum-Gold Mining Co., operating this property under bond, has increased force of men. Vein has been intersected on third level. It is reported that money is on hand for second payment on property, due June 1, and an experimental plant will soon be constructed for treatment of the gold-platinum ore. At present, only copper carbonate ore is being shipped, pending completion of tests on platinum ore.

FREDRICKSON (Goodsprings) — Dry concentrating plant recently erected now in full operation, using rolls and Plumb pneumatic jigs. Consignment of Sutton, Steele & Steele tables on way, and will be used for the treatment of the finer sizes not suited to jigs. Ore is lead carbonate, carrying high silver values, in silicious limestone gangue. Process is proving very successful. Mr. F. C. O'Kelly is manager.

Esmeralda County

SANDSTORM & KENDALL (Goldfield)—Formulating plans for working considerable area of placer ground lying on either side of ridge, partly on Sandstorm and partly on Kendall.

NEVADA GOLDFIELD REDUCTION (Goldfield) — Six months' lease granted to association of Tonopah men by Champ d'Or French mining company, present owners of mill, who own also mining properties at Hornsilver and Gold Mountain. Lessees intend to carry on tests in plant on treatment of slimes from Tonopah ores. Plant has capacity of 300 tons per day.

Humboldt County

HONEY BEE (Willard)—Gold ore being sacked on this claim, scene of original strike at this new camp. Other shoots discovered and preparations being made to ship high-grade ore from surface. Townsite surveyed on Apr. 7; 300 people now in camp and many buildings and houses being built.

NEW GOLD STRIKE NEAR ROCHESTER, between Weaver and Rochester cañons, one mile from Short Line R.R., made recently; oreshoot 4 ft. wide, assaying $50 in gold opened; sinking now under way.

Lander County

SILVER STRIKE ON BIRCH CREEK made recently. Fifty-foot shaft opened 4-ft. shoot, 8 in. of which assays $200 per ton in silver. Shipment being mined.

Lyon County

MASON VALLEY (Thompson)—Smeltery still closed but crew working at plant testing leaching process. Company has just purchased two wedge roasters.

NEVADA PROGRESSIVE CO. (Yerington)—Shaft now down 272 ft. Station will be cut and drifting done on 300 level. Lateral development work under way on 60, 100 and 200 levels. Ore changed from oxide to sulphide at depth of 250 ft. Mill may be built this summer.

Mineral County

AURORA CONSOLIDATED (Aurora)—Goldfield Consolidated owns 87% of stock of this company for which it paid $763,011, equivalent to $1.288 per share. Forty-stamp mill started up and running to capacity, 700 tons per day.

Nye County

TONOPAH ORE PRODUCTION for week ended Apr. 17 was 10,760 tons estimated value $219,640 compared with 10,913 tons last week. Shippers were: Tonopah Belmont, 3681; Tonopah Mining, 2800; Tonopah Extension, 1760; West End, 805; Jim Butler, 1150; Tonopah Merger, 150; North Star, 50; and Halifax, 364 tons.

TONOPAH BONANZA (Tonopah)—Power will be supplied and mining operations started at once.

TONOPAH MIDWAY (Tonopah)—Shaft sinking suspended while preparations for installation of new compressor are being made.

VICTOR (Tonopah)—Water being lowered at rate of 3½ ft. per day. Entire mine will be unwatered in 30 or 40 days.

Washoe County

RED METAL COPPER (Reno)—This company situated at base of Peavine Mountain about 10 miles from Reno, has been sold to Charles B. Bills, of Sacramento, who plans to install leaching plant for reduction of his ores.

MONITOR BELMONT (Belmont)—Ten-stamp mill, using 1650 stamps will be placed in commission July 4 with big celebration. In addition to stamps and tube mill, milling method will include oil flotation. Mill building will be constructed of brick obtained from razing of old combination mill built more than 40 years ago, about one mile from present mill site.

White Pine County

NEVADA STAR (Cherry Creek)—Has just paid out $12,000 to 40 lien claimants and freed this old time silver property from legal complications. Dominant parties in Star company at Leeds, England, have cabled that operations will be resumed shortly at Cherry Creek.

NEVADA CONSOLIDATED (Ely)—Is running full time, handling more than 10,000 tons daily. Having installed agitators and flotation machines in six sections of mill will require so much power that it has had to order more electrical equipment, which will cost quarter of a million dollars.

OHIO

Mahoning County

CARBON LIMESTONE CO. (Youngstown)—Has recently expended about $125,000 on its properties at Hillsville, Penn., putting in large crushers, steam shovels, etc. Output approximates 1,000,000 tons a year. It owns in fee in its quaries about 30,000,000 tons of limestone and has under lease 600 acres of additional limestone territory. Has five miles of its own railroad tracks. Plant has just been installed for crushing limestone to degree of fineness suitable for agricultural purposes. Robert Bentley is president.

OREGON

Baker County

IMPERIAL MINE (Cable Cove District)—Ore being hauled for shipment to smeltery till mill is in operation.

POWDER RIVER GOLD DREDGING (Sumpter)—Dredging, introduced in Baker County two years ago by this company, branch of Keystone Dredging Co. of San Francisco which operates many dredges in California and Alaska, will, within next year, be one of principal methods of extracting gold in this section. Many old placer grounds will be scenes of activity. This company is to install another dredge; above Sumpter is Gold Center dredge; on Pine Creek, below Underwood placers another dredge will be installed. Besides these several others are contemplated.

Josephine County

ORIOLE MINE (Galice District)—Action has been filed in circuit court, W. C. Boyd, plaintiff, in which appointment of receiver is asked. Suit brought to protect interests of holders of claims against the company and to maintain property without impairment for its stockholders.

DEL NORTE CLAIM HOLDERS' ASSOC. (Illinois River)—Dr. Chas. H. Parke, of Chicago, vice-president of this company, in company with B. F. Sanford, of Grants Pass are making investigations at mine where wagon road is being built and other improvements made with view to re-opening. This is a high-grade copper property.

M. J. ANDERSON AND COREY MATTISON (Grants Pass)—Are developing promising antimony property near Watkins post office. The vein is 5 ft. in width and ore assays 60% antimony.

UTAH

Beaver County

MAJESTIC (Milford)—Operations are to be resumed.

CROFT (Milford)—This property, 11 miles from Milford, has been examined for Eastern people. Lead ore has been shipped in past. Development consists of shallow workings. Main shaft down 125 feet.

ROB ROY (Newhouse)—Arrangements for resumption of work have been completed. Property five miles north of Sheep Rock.

FORTUNA GOLD QUEEN (Beaver City)—High-grade ore is reported to have been opened in a tunnel 60 ft. from surface. Stock to be listed on Salt Lake Exchange.

Juab County

TINTIC ORE SHIPMENTS for week ended Apr. 16 largest for months, 123 cars, estimated 6150 tons, value $150,000, compared with 106 cars week previous and 103 cars second week previous.

BULLION BECK (Eureka)—Concentrates are being produced by jigging ore from old stopes leased to Goodwin, Anderson & Watkins. Two cars shipped week ended Apr. 16.

YANKEE (Eureka)—Work being done in western part of property in search of continuation of recently developed orebody in May Day. In southern end prospecting is being done for Beck Tunnel vein.

EAGLE & BLUE BELL (Eureka)—New orebody on 1750 level has been opened 200 ft. along strike. Prospecting downward from 1750 has been started, and if body is found to extend to much greater depth main shaft will be deepened.

KNIGHT-CHRISTENSEN MILL (Silver City)—New mill to have same capacity as old, 100 tons daily, and to be built as unit, so capacity can be increased easily. Steel from Knight smeltery to be used in construction, as precaution against fire. Machinery remaining from destroyed mill is being overhauled; new equipment to be ordered immediately. Expected to have mill ready for operation in three months.

Salt Lake County

MONTANA-BINGHAM (Bingham)—Surface survey being made of ground to be served by this company's development and transportation tunnel. The tunnel is at present in about 3360 ft. and daily progress of 3 to 4 ft. is being made.

UTAH KARNS TUNNELING MACHINE CO. (Salt Lake City)—J. R. Belcher, president, states that company has just entered into contract with City of Chicago for installation of one heading machine to operate on eight-mile channel to be driven under city. Machine is to bore relief holes 12 in. in diameter and 15 ft. deep, to be used in connection with round of air drill holes put in as usual. He states that actual tests made by firing to this big centre relief hole have shown that speed of tunneling is increased about 50%. In Hercules tunnel at Wallace, Idaho, Karns machine bored three 15-ft. holes at a rate of 2½ ft. per hour.

Summit County

PARK CITY SHIPMENTS of ore and concentrates for week ended Apr. 17 amounted to 1300 tons, valued at $52,000, compared with 1218 tons week previous and 1505 tons second week previous.

NEW QUINCY (Park City)—Articles of incorporation have been filed, new company taking over rights and obligations of Thompson-Quincy. Ground comprises 140 acres, patented. Company owns rights of way and easements with Ontario, Daly and Daly-West mines. Capitalization is 1,250,000 shares, par value 10c., with 205,065 shares in treasury. Within next 90 days old stockholders will receive 1,045,035 shares of new stock share for share, or may sell their stock to the company at 10c. a share, to be deposited in the treasury. Debts of the company amount to about $44,000. Not more than 3c. may be levied in assessments the first year, 1c. at a time, the second assessment five months after the first, and the third, 10 months. W. Mont Ferry is president.

CANADA

British Columbia

CONSOLIDATED MINING & SMELTEING (Trail)—During week ended Apr. 10, ore from 11 mines was treated by smeltery at Trail amounting to 7741 tons. Largest individual shipper was Centre Star.

GRANBY CONSOLIDATED (Grand Forks)—Blister copper from Anyox and Granby smelteries will hereafter be shipped to eastern refineries via Panama Canal. This will take longer for product to reach destination, but saving of more than 50% in freight, compared with all-rail haul across continent, more than compensates.

Ontario

NIPISSING—During March mined ore estimated net value $169,079.

TOUGH OAKES—(Kirkland Lake)—Has been running at about half capacity owing to power shortage. First clean-up in mill showed extraction of about 95%.

KRIST-THOMPSON (Porcupine)—Formerly Krist Porcupine Mining Co. has taken over South Thompson property. Diamond drilling is to be started shortly.

BEAVER (Cobalt)—At annual meeting held this week Mr. Culver announced that Beaver and Temiskaming mines would jointly build power plant to cost about $150,000.

McINTYRE (Porcupine)—A Toronto broker is asking shareholders to give him their proxies in order to oust present directorate, whom it is claimed do not take proper interest in property.

VIPOND (Porcupine)—Mill will shortly be in shape to handle 150 tons per day. In March with daily capacity of 85 tons, ore of value of $32,000 was milled and for April output is estimated at $40,000, while for year total production will probably be about $500,000.

The Market Report

METAL MARKETS

NEW YORK—Apr. 28

Copper and spelter both experienced phenomenal advances. On the other hand, the markets for tin and lead were quiet and stationary.

Copper, Tin, Lead and Zinc

Copper—The performance of copper during the last week substantially repeated that of the week immediately preceding. During each day there was a sharp advance from the opening to the closing of business. On Apr. 27 a large business was done upon the basis of 18½c., regular terms, equivalent to about 18.30, net cash, New York, but toward the end of the day, small sales were made at 18¾c., while there were still sellers at 18½c. On April 28 the market opened at 18⅝c., and at 3 p.m., our closing time, was at 18¾@18⅞c., regular terms, with indications, however, that a higher price might be made before the end of the day.

The volume of business was fairly large, there being numerous million-pound transactions and larger. While the bulk of business continued to be for military purposes, there was a further increase in the demand for domestic peaceful purposes.

The great and extraordinary rapid advance in the price for copper is deplored by all who have the best interests of the industry at heart, but it has been impossible to check it. Although the mines are increasing their output, the increase is not yet reflected in the working of the refineries which are still being operated at below normal capacity. The recent advance is adequately explained by the statement that the refiners have not been able to sell freely enough to check it.

Copper Exports for the week ended Apr. 17 are reported by the Department of Commerce at 10,098,634 lb. The larger items were 5,797,634 lb. to Great Britain; 2,298,596 lb. to France; 1,360,329 lb. to Italy and 560,335 lb. to Russia. Imports were 2,528,000 lb. metal and 9,645,000 lb. in ore and matte; 12,173,000 lb. in all. The larger imports were from Cuba, Venezuela and Japan.

Copper Sheets base price was advanced ½c. per lb. on Apr. 22, and is now 23c. per lb. for hot rolled and 24c. for cold rolled. Usual extras charged and higher prices for small quantities. Copper wire is 19@19¼c. per lb. carload lots at mill.

Tin—This metal has been quiet with only a small volume of business transacted. It is satisfactory that the recent excitement has practically passed away.

Tin shipments from the Straits in March were 5250 long tons. For the three months ended Mar. 31 the total was 15,972 tons in 1914 and 15,905 in 1915, a decrease of 67 tons.

Lead—The bulk of the business last week was apparently taken by the largest producer. Some large foreign orders were in the market and also some large orders from domestic manufacturers who are making ammunition. While the St. Louis quotation remains unchanged the bulk of the business there appears to have been done at about 4.10c., while there were reports of small sales a little lower than that.

Spelter—Inspired by the spectacular rise in the price for spot spelter at London, which price was £51 at the beginning of the week and £64½ at the end, dealers, traders and speculators ran away with this market. There is practically no spot spelter in London, and practically no prompt spelter here. The transactions in this market, on St. Louis basis, during the last week were of extraordinary character, being in the main for deliveries ranging all over the remainder of this year, and being at phenomenal variations in price. The only way of quoting the market is by giving the range, including all reported transactions of magnitude, although such a range in quotations is quite unprecedented. The total volume of business was large, amounting without any doubt to upward of 10,000 tons, and to a large extent was for export. The amount of business done with consumers, domestic and foreign, was relatively small, probably not more than 25% of the total. Transactions in prompt and May spelter amounted to only a few hundred tons, mostly in 25- and 50-ton lots.

Zinc sheets, base price was advanced ¼c. Apr. 22; ¾c. Apr. 23, again on Apr. 25, and is now $16 per 100 lb., f.o.b. La Salle, Ill., less 8% discount. Usual extras charged. The demand is reported good.

G. D. Delprat, general manager of the Broken Hill Proprietary Co., is reported as saying, Feb. 5: "We are producing spelter as fast as we can. We have nine furnaces at work, and a tenth is being blown in. We are producing over 100 tons a week of spelter. All of this is being disposed of in Australia. I cannot say much about zinc concentrates, but we are looking for a market in America and have someone traveling there at the present time."

At the annual meeting of the directors of the Edgar Zinc Co., held Apr. 6, the following officers were elected for the ensuing year: S. C. Edgar, Jr., president; A. S. McMillan, vice-president and auditor; W. B. Edgar, secretary and treasurer. From Apr. 19 the general offices of the company are in Suite 910, Boatmen's Bank Building, Broadway and Olive St., St. Louis.

DAILY PRICES OF METALS IN NEW YORK

Apr.	Sterling Exchange	Silver, Cts. per Oz.	Copper	Tin	Lead		Zinc	
			Electrolytic, Cts. per Lb.	Spot, Cts. per Lb.	New York, Cts. per Lb.	St. Louis, Cts. per Lb.	New York, Cts. per Lb.	St. Louis, Cts. per Lb.
22	4.7887	50⅛	17.55 @17.70	42	4.20 @4.25	4.10 @4.15	9.42½ @11.67½	9.25 @11.50
23	4.7894	50⅝	17.55 @17.70	42	4.20 @4.25	4.10 @4.15	9.67½ @12.17½	9.50 @12.00
24	4.7887	50⅝	17.70 @17.80	42	4.20 @4.25	4.10 @4.15	9.67½ @12.17½	9.50 @12.00
26	4.7913	50¾	17.75 @18.05	42	4.20 @4.25	4.10 @4.15	10.17½ @12.67½	10.00 @12.50
27	4.7944	50½	18.10 @18.50	42	4.20 @4.25	4.10 @4.15	10.67½ @13.17½	10.50 @13.00
28	4.7919	50⅝	18.45 @18.70	42	4.20 @4.25	4.10 @4.15	11.17½ @13.17½	11.00 @13.00

The quotations herein are our appraisal of the average markets for copper, lead, spelter and tin based on wholesale contracts for the ordinary deliveries of the trade as made by producers and agencies; and represent, to the best of our judgment, the prevailing values of the metals, reduced to basis of New York, cash, except where St. Louis is given as the basing point. St. Louis and New York are normally quoted 0.17c. apart.

The quotations for electrolytic copper are for cakes, ingots and wirebars. Electrolytic copper is commonly sold at prices including delivery to the consumers and is subject to discounts, etc. The difference between the price delivered and the New York cash equivalent is at present 0.15 to 0.20c. on domestic business. The price of electrolytic cathodes is 0.05 to 0.10c. below that of electrolytic. Quotations for lead represent wholesale transactions in the open market for good ordinary brands. Quotations for spelter are for ordinary Prime Western brands. Silver quotations are in cents per troy ounce of fine silver.

Some current freight rates on metals per 100 lb. are; St. Louis-New York, 17c.; St. Louis-Chicago, 6.3c.; St. Louis-Pittsburgh, 13.1c.

LONDON

Apr.	Silver	Copper				Tin		Lead		Zinc	
		Spot		3 Mos.	Best Sel'td	Spot	3 Mos.	£ per Ton	Cts. per Lb.	£ per Ton	Cts. per Lb.
		£ per Ton	Cts. per Lb.								
22	23 13/16	77½	16.84	78¼	....	163¼	164	20⅞	4.54	51	11.08
23	23⅞	78¾	17.11	79¾	....	165	165¾	21⅛	4.59	53½	11.62
24	23⅞	.....	.....	....	....	.....	....	.....	.....	....	....
26	23 15/16	79¾	17.33	81	....	165¼	166	21⅛ 20¼	4.67 4.54	57¾	12.55
27	23 13/16	81¼	17.65	82½	....	164½	165¼	@21¼	@4.62	59	12.82
28	23⅞	80⅝	17.52	82	....	163½	164½	21¼	4.62	64½	14.01

The above table gives the closing quotations on London Metal Exchange. All prices are in pounds sterling per ton of 2240 lb., except silver which is in pence per troy ounce of sterling silver, 0.925 fine. Copper quotations are for standard copper, spot and three months, and for best selected, price for the latter being subject to 3 per cent. discount. For convenience in comparison of London prices, in pounds sterling per 2240 lb., with American prices in cents per pound the following approximate ratios are given, reckoning exchange at 4.80. £15 = 3.21c.; £20 = 4.29c.; £30 = 6.43c.; £40 = 8.57c.; £60 = 12.85c. Variations, £1 = 0.21⅜c.

Other Metals

NEW YORK—Apr. 28

Aluminum has been a little more active but steady and with no change to be noted. Quotations are 18¾@19c. per lb. for No. 1 ingots, New York.—**Antimony** has advanced sharply on limited business. Stocks are small and no increase in supply is in sight. Ordinary brands are 26@27c. per lb.; while 34c. per lb. is asked for Cookson's.—**Nickel** is steady and unchanged. Ordinary forms are 40@45c. per lb, according to size and terms of order. Electrolytic, 3c. per lb. higher.—**Quicksilver** is in better demand in a small way. The New York price is $65@70 per flask of 75 lb. for large lots. A round lot was sold at $70 on Apr. 26. Small lots are sold at $70@80 per flask, according to size of order. San Francisco price is telegraphed at $62.50@65 for domestic orders, large lots. Some dealers hold for $75, but without sales. London price is £12 per flask, with £11 17s. 6d. named from second hands.

Minor Metals—Current sales of **Bismuth** have been at $2.75 @3 per lb., New York.—**Selenium**—Quotations are $2@3 per lb. for larger quantities; $4.50@5 per lb. for smaller lots.—**Cadmium** is quoted in London at 6s.—$1.44—per lb.—**Tellurium** is reported sold at 80s.—$19.20—per lb. in London.

Gold, Silver and Platinum

Gold and Silver Movement in the United States, three months ended Mar. 31, is reported by the Department of Commerce as below:

	Gold		Silver	
	1914	1915	1914	1915
Exports	$18,624,883	$2,669,279	$11,483,600	$11,768,105
Imports	21,493,475	45,243,357	6,799,568	7,163,929
Excess	I.$2,868,592	I. $42,574,078	E. $4,684,032	E. $4,604,176

Exports of merchandise for the three months are valued at $866,694,745; imports, $405,311,924; excess of exports, $461,382,821. Adding gold and silver gives $367,342,022 as the net export balance.

Gold imports into Great Britain, three months ended Mar. 31, were £3,789,201; exports, £2,339,832; excess of imports, £1,449,369, against £1,733,296 last year.

Silver has been steady with slight advancing tendency the past week, having touched 23 1/16d. There are no new features to the market.

Platinum—The market continues quiet and with very small movement. Quotations remain about the same, $38@40 per oz. for refined platinum and $43@47 per oz. for hard metal, according to grade.

Our Russian correspondent writes that the market is dull and inactive as is usually the case before the Easter holidays. In Petrograd there are no quotations, owing to the absence of sales. At Ekaterinburg the price is 8 rubles per zolotnik—$30.08 per oz.—for crude metal, 83% platinum, but this is largely nominal. The Russian government now permits the export of platinum under special conditions. In accordance with the new regulations a platinum refinery is to be erected in the Urals next summer.

Zinc and Lead Ore Markets

PLATTEVILLE, WIS.—Apr. 24

The base price paid this week for 60% zinc ore was $58 per ton. Lead ore, 80%, was sold at a base price of $51 per ton.

SHIPMENTS WEEK ENDED APR. 24

	Zinc Ore, Lb.	Lead Ore, Lb.	Sulphur Ore, Lb.
Week	3,752,390	90,000	654,120
Year	62,169,150	1,639,190	6,470,410

Shipped during week to separating plants, 4,387,760 lb. zinc ore.

JOPLIN, MO.—Apr. 24

Blende, high price, $68; assay base 60% zinc, premium grades, $65@66; medium grades, $63@58, and lower grades down to $54 per ton. Calamine, base, $42@38 per ton of 40% zinc; average, all grades of zinc, $54.40 per ton. Lead, high price $52.50; base, $51 per ton of 80% metal content.

SHIPMENTS WEEK ENDED APR. 24

	Blende	Calamine	Lead	Values
Totals this week	11,802,860	1,367,750	1,115,610	$387,390
Totals this year	172,110,310	15,388,800	25,576,680	6,071,550

Blende value, the week, $332,700; four months, $5,162,100.
Calamine value, the week, $26,400; four months, $279,980.
Lead value, the week, $28,290; four months, $609,470.

Purchases were as heavy or heavier than the previous week, and prices advanced from $5 to $10 per ton for ore for next week's delivery.

Iron Trade Review

The reported tone of the iron and steel markets is still good. While domestic business improves gradually, foreign orders are large.

The condition of the trade changes slowly, but there seems to be no recession, and the mills hold their own and gain a little from day to day.

Pig iron shows some gain and the increasing production is taken up. There has been a fair demand for basic and foundry iron. Southern furnaces have made sales of something like 200,000 tons of those grades at prices running up to $9.50 and $9.75 for No. 2 foundry at furnace.

Imports at Baltimore for the past week included 325 tons ferromanganese from Liverpool.

Among the exports from Baltimore for the week was an unusual item 12,965,300 lb. pipe for Abadan, Persian Gulf.

United States Steel Corporation reports for the quarter ended March 31 an increase of $1,522,639 in net earnings over the December quarter of 1914. The net earnings below include balance after payment of all operating expenses, ordinary renewals and repairs:

	1914	1915
January	$4,941,337	$1,687,150
February	5,655,611	3,638,578
March	7,397,433	7,132,081
Net earnings for quarter	$17,994,381	$12,457,809
Depreciation and sinking funds		$5,773,236
Bond interest, etc		5,769,515
Total charges		$11,542,758
Surplus for the quarter		$915,051

The usual dividend of 1¾% on preferred stock was declared, amounting to $6,304,919, leaving a deficit of $5,389,861. The notable point is the large increase in net earnings in March.

PITTSBURGH—Apr. 27

The steel mills continue to operate at about 70% of capacity, but there has been no disposition to increase the rate in the past two or three weeks, and there is a question even whether the rate can be maintained. Current bookings are not as heavy as in March, but as consumers having low-priced contracts expiring Apr. 1 specified heavily in March there is a possibility that buying will shortly be heavier.

Shipments of wire products are decreasing, as they always do at this season, but the season is considered a backward one and it is expected that May and June shipments will therefore be fairly large. Shipments to agricultural implement makers have decerased, but are still fairly large, and the implement makers have already begun to figure on material for the new season. Shipments to the automobile trade have also decreased, but some of the car builders have already bought some material to apply to 1916 models. In all three of these classes of material the between-seasons lull is expected to be less pronounced than usual.

Railroads are specifying more heavily against their contracts for rails and track material. The Western Maryland is inquiring for 1000 steel hopper cars, while the Chicago & Northwestern's order for 2500 box cars is likely to be placed shortly. The Pennsylvania R.R. has inquired for a fair volume of material for cars and locomotives to be built at its Altoona shops, but has not inquired against the larger number of cars and locomotives it stated recently it might buy this season on the outside.

War orders for steel are making up a round tonnage. To date the Steel Corporation is understood to have taken orders for 50,000 tons of bars for making shrapnel, and the Lackawanna Steel Co. 45,000 tons, orders placed with other mills being relatively small.

Steel prices are well maintained, but are subject to no severe tests. The wire mills are insisting on 60c. per 100 lb. differential for galvanized wire, while most of the independent mills have withdrawn the 3.40c. price on galvanized sheets, a price the leading interest still quotes, as it has spelter bought at prices lower than the present market.

Pig Iron—The Youngstown Sheet & Tube Co. has bought about 40,000 tons of basic pig iron, 17,500 tons of gray forge and 5000 tons of foundry iron, over 60,000 tons in all, for delivery up to Oct. 1. It is operating its four blast furnaces, but is running its steel departments practically full and therefore needs outside pig iron. No statement is made as to prices paid, and the trade generally seems to assume that current quotations were shaded. W. P. Snyder & Co. yesterday sold 10,000 tons of bessemer for export to Italy, securing $16, seaboard, or $13.86 at furnace, 26c. above the domestic market as lately quoted. There is more interest in foundry iron. We continue to quote: Bessemer, $13.60; basic, $12.50; No. 2 foundry, $12.75@13; forge, $12.50@12.75; malelable, $12.75, f.o.b. Valley Furnaces, 95c. higher delivered Pittsburgh.

IRON ORE

NEW YORK—Apr. 28

The prices of Lake Superior iron ore to buyers for this season have been fixed by large sales made at Cleveland and in the Mahoning Valley. The prices made are the same as those for 1914, being $3.75 per ton for Old Range bessemer; $3.50 for Mesabi bessemer; $3 for Old Range nonbessemer; $2.85 for Mesabi nonbessemer; all on docks at Lake Erie ports. The basis remains the same, 55% iron and under 0.45% phosphorus for bessemer ores; 51.5% iron for nonbessemers. It is understood that the Lake rate will be unchanged at 50c. from Duluth to Lake Erie ports, including unloading charges.

Some good sales of Lake Champlain lump ore to open-hearth steel furnaces in the United States and Canada are reported made recently.

The water level on the Lakes this year is reported unusually low. The first boats down will be loaded on 19-ft. draft, and it is possible the limit may be reduced to 18½ ft. This means that there will be no record ore cargoes this season. Navigation is reported clear and shipments will begin early.

British Iron Ore Imports three months ended Mar. 31 were 1,557,320 long tons in 1914, and 1,295,132 in 1915; decrease, 262,188 tons. Imports of Manganese ore were 128,775 tons in 1914, and 86,605 in 1915; decrease, 42,170 tons.

FOREIGN IRON NOTES

The German Iron & Steel Union reports the production of pig iron in the German Empire in February at 803,623 metric tons, which is 70,510 tons less than in January and 874,133 tons less than in February 1914. For the two months ended Feb. 28 the total make was 3,012,365 tons in 1914, and 1,445,670 in 1915; a decrease of 1,566,695 tons, or 52%, this year.

The German Iron & Steel Union reports the make of steel in February at 946,015 tons, or 17,775 tons less than in January. For the two months ended Feb. 28 the total was, in metric tons:

	Basic	Acid	Total
Converter	972,278	20,908	993,186
Openhearth	785,841	32,128	817,969
Direct castings	50,077	15,119	65,196
Crucible steel	.....	17,074	17,014
Electric steel	.....	16,440	16,440
Total	1,808,196	101,609	1,909,805

The total make in January and February, 1914, was 3,112,-265 tons, showing a decrease this year of 1,202,460 tons, or 38.6%. There were 229 steel plants in operation in February.

Foreign Trade of Great Britain in Iron and Steel, two months ended Feb. 28, as valued by the Board of Trade returns:

	Exports	Imports	Excess
Iron and steel	£4,907,375	£999,454 Exp.	£3,907,921
Machinery, hardware, etc.	4,380,705	1,915,849 Exp.	2,464,856
Totals	£9,288,080	£2,915,303 Exp.	£6,372,777
Totals, 1914	18,250,533	4,987,793 Exp.	13,262,740

Actual tonnage of iron and steel exported was 801,097 tons in 1914, and 418,570 tons in 1915; imported, 360,523 tons in 1914 and 117,733 tons this year.

COKE

Connellsville—The coke market continues to grow in strength, at least sentimentally, and it is said that only a little more buying for early delivery would serve to stiffen prices materially. Two inquiries are now out for second half, totaling about 20,000 tons a month, from consumers who are already covered to July 1. There is an unconfirmed rumor that a contract for 20,000 tons monthly for the twelve-month beginning July has been made at $1.95. We quote: Prompt furnace, $1.55@1.60; contract furnace to July 1, $1.60@1.65; contract furnace, second half, $1.75; prompt foundry, $2@2.35; contract foundry, $2.20@2.30, per net ton at ovens.

The "Courier" reports production in the Connellsville and lower Connellsville region in the week ended Apr. 17 at 298,-222 tons, an increase of 6007 tons, and shipments at 294,995 tons, an increase of 7166 tons.

Coal and Coke Tonnage of Pennsylvania R.R. lines east of Pittsburgh and Erie, three months ended Mar. 31, in short tons:

	1914	1915	Changes
Anthracite	2,655,435	2,480,729	D. 174,706
Bituminous	11,530,144	9,845,684	D. 1,684,460
Coke	2,682,470	2,303,835	D. 378,635
Total	16,868,049	14,630,248	D. 2,237,801

The total decrease this year from 1914 was 13.3%. The lightest tonnage reported was in March when the total was 24% less than in March a year ago.

Fuel Exports and Imports in the United States, two months ended Feb. 28, as reported by the Department of Commerce, in long tons:

	Exports		Imports	
	1914	1915	1914	1915
Anthracite	404,228	368,539	107	11
Bituminous	1,690,069	1,218,033	229,476	252,997
Coke	128,412	101,756	13,131	6,718
Bunker coal	1,143,181	1,030,867	.....	.....
Total	3,365,890	2,719,195	242,714	259,726

The bunker coal, or coal furnished to steamships in foreign trades, is practically all bituminous. The greater part of the trade, both imports and exports, is with Canada.

Coal Production in South Africa in 1914, as reported by the Mines Department of the Union of South Africa, was: Transvaal, 5,157,268; Orange Free State, 699,217; Natal, 2,567,-817; Cape, 53,621; total, 8,477,923 tons, being 323,293 tons less than in 1913. The decrease was in Natal chiefly. In December there were 58 collieries producing coal in the Union: Transvaal, 25; Cape, 8; Orange Free State, 4; Natal, 21. At these collieries there were employed 1212 whites and 23,805 colored workmen.

Consular reports say that from a recent report of the Ministry of Agriculture & Commerce at Peking it appears that the output in coal in the various provinces of China in 1914 was 9,272,000 tons, divided as follows: Manchuria, 840,000; Hupeh, 100,000; Chihli, 2,160,000; Anhuei, 60,000; Shansi, 2,500,000; Shantung, 932,000; Honan, 900,000; Szechwan, 300,000; Kiangsi, 800,000; Hunan, 500,000; Shensi, 50,000; Kwangtung, 50,000; Kansu, 50,000; Yunnan, 30,000 tons.

Chemicals

NEW YORK—Apr. 28

The general market shows a little more activity in places, but is still inclined to be variable.

Arsenic—Business is improving, but is not more than moderately active. Prices are steady at about $4 per 100 lb. for both spot and futures.

Copper Sulphate—Business is good. The price has been advanced 50c. and is now $6.75 per 100 lb. for carload lots and $7 per 100 lb. for smaller parcels.

Nitrate of Soda—The market is firm and steady on a moderate business. Quotations remain 2.30c. per lb. for all positions this year.

Potash Salts—The American steamship "L. V. Stoddard" is reported at Wilmington, N. C., from Rotterdam with a cargo of 2200 tons of muriate of potash. This is the first cargo of German potash received there since August last.

Imports and Exports of Chemicals in the United States, two months ended Feb. 28, in pounds:

	Imports		Exports	
	1914	1915	1914	1915
Arsenic	754,613	1,035,675	.....	660
Bleach	8,311,243	8,521,327	8,600	.....
Potash salts	6,461,135	9,558,906	186,798	42,645
Acetate of lime	.....	.....	7,470,670	3,316,740
Calcium carbide	.....	.....	6,900,960	6,457,816

Exports include reëports of foreign material. Imports of soda salts not given in quantities; values were $109,070 in 1914 and $150,012 in 1915. Potash salts do not include the crude salts used in fertilizer manufacture.

Imports and Exports of Raw Material for chemical manufacture, two months ended Feb. 28, in long tons:

	Imports		Exports	
	1914	1915	1914	1915
Sulphur	3,126	1,764	15,916	1,008
Pyrites	140,887	82,672	.....	.....
Chrome ore	22,780	5,000	.....	.....
Magnesite	25,454	6,141	434	337

Exports include reëxports of foreign material. Estimating sulphur contents of pyrites, the total sulphur imported this years was 34,832 tons.

Imports and Exports of Fertilizing Chemicals, two months ended Feb. 28, in long tons:

	Imports		Exports	
	1914	1915	1914	1915
Kainit	140,508	2,158	.....	.....
Manure salts	38,145	1,839	.....	.....
Other potash salts	54,592	52,408	600	398
Nitrate of soda	57,213	48,092	1,174	5,225
Sulphate of ammonia	17,802	14,286	.....	24
Phosphates	.....	.....	173,757	4,750

Exports include reëxports of foreign material. Some phosphates are imported, but are not given separately in the returns.

Assessments

Company	Delinqe	Sale	Amt.
Advance, Mont.	May 1	June 1	$0.005
Andes Silver, Nev.	May 4	May 25	0.03
Belcher, Nev.	May 15	June 8	0.15
Best & Belcher, Nev.	May 12	June 1	0.05
Big Elk, Ida.	Apr. 15	May 15	0.001
Bobby Anderson, Ida.	Apr. 12	May 3	0.0025
Caledonia, Nev.	May 11	June 1	0.05
Cedar Creek, Ida.	May 5	June 5	0.005
Consolidated Imperial, Nev.	Apr. 27	May 18	0.01
Con. Virginia, Nev.	May 4	May 25	0.10
Contact Copper, Mich.	May 15	.....	0.50
Crown Point, Nev.	May 17	June 8	0.15
Diam'field Black Butte, Nev.	Apr. 30	June 3	0.01
East Hercules, Ida., (pcst.)	.....	May 15	0.001
Emerald, Utah (three instal.)	.....	June 9	0.01
Exchequer, Nev.	May 11	June 1	0.03
Florence, Ida.	Apr. 15	May 4	0.001
Gethin Le Roy, Utah	Apr. 21	May 6	0.01
Giant, Ida.	Apr. 9	May 14	0.002
Houghton, Mich.	May 25	.....	1.00
Idaho-Los Angeles, Ida.	Apr. 24	May 15	0.005
Idaho-Nevada, Ida	May 10	June 5	0.002
Ivanhoe, Ida.	Apr. 10	May 10	0.002
Knight Christensen, Utah	.....	.....	0.13
Majestic-Idol, Nev.	Dec. 15	Jul. 20	0.005
Mullan, Ida.	Apr. 24	May 24	0.002
Mountain Rose, Ida.	Apr. 19	May 19	0.001
Nevada-Douglas, Nev	Apr. 24	June 10	0.10
New Arcadian, Mich.	June 1	.....	0.50
New Hope, Ida.	May 5	June 2	0.002
Pandora, Ida.	Apr. 15	May 7	0.003
Raven, Ida.	May 15	June 14	0.0006
Samson, Ida (post)	.....	June 3	0.002
Sandstorm Kendall, Nev.	Apr. 1	May 6	0.01
Sierra Nevada, Nev.	May 10	June 1	0.05
Silver Moon, Ida.	May 18	June 18	0.005
Silver Mountain, Ida.	May 15	June 15	0.002
Smuggler	Apr. 17	May 17	0.0025
Sunset, M. & D., Nev.	Mar. 27	May 3	0.015
Tarbox, Ida.	Apr. 26	May 28	0.0025
Virginia, Ida.	May 10	May 29	0.02
Yellow Jacket, Nev	May 14	June 8	0.15

Stock Quotations

Sales at auction: 100 shares Victoria Gold, $27 lot; 5000 shares Victoria Extension, $50 lot; 2978 shares Yaqui Copper Co., $45 lot; 11,000 shares California Consolidated Oil Co., and 6000 shares Donaldson Mountain Mining Co., $10 lot.

COLO. SPRINGS Apr. 26		SALT LAKE Apr. 26	
Name of Comp.	Bid.	Name of Comp.	Bid.
Acacia	.05	Beck Tunnel	.06½
Banner	.01	Black Jack	.10½
Cripple Cr'k Con.	.01¼	Colorado Mining	.11½
C. K. & N.	.05	Crown Point	.01¼
Doctor Jack Pot	.08½	Daly-Judge	5.25
Elkton Con.	.43½	Gold Chain	.09½
El Paso	1.10	Grand Central	.60
Findlay	.03½	Iron Blossom	.76
Gold Dollar	.02½	Little Bell	.15
Gold Sovereign	.04½	Lower Mammoth	.05
Isabella	.19½	Mason Valley	3.50
Jack Pot	.06½	May Day	.14
Jennie Sample	.02	Opohongo	.01½
Jerry Johnson	.05½	Prince Con.	.43
Lexington	.008	Seven Troughs	.02
Mary McKinney	.32	Silver King Coal'n.	3.37½
Pharmacist	.008	Silver King Con.	1.85
Portland	1.18	Sioux Con.	.03½
Raven B. H.	.03½	Uncle Sam	.04
Vindicator	1.62	Yankee	.05½

TORONTO Apr. 26			
Bailey	.02½	Dome Exten.	.10
Coniagas	4.75	Foley O'Brien	.24
Peterson Lake	.25	Hollinger	24.00
Right of Way	.05	Imperial	.06½
Seneca Superior	1.37½	Jupiter	.13
Silver Queen	.01½	McIntyre	.54
T. & Hudson Bay	17.00	Pearl Lake	.01½
Timiskaming	.38	Porcu. Gold	‡.25
Wettlaufer-Lor.	.04	Preston E. D.	.02½
Big Dome	13.50	Rea	.12

SAN FRANCISCO Apr. 26			
Comstock Stocks		Misc. Nev. & Cal.	
Alta	‡.04	Belmont	4.90
Andes	.02	Jim Butler	.99
Belcher	.08	Lone Star	.08
Best & Belcher	.01	MacNamara	.03
Caledonia	.15	Midway	.18
Challenge Con.	‡.06	Mont.-Tonopah	.35
Confidence	‡.15	North Star	.17
Con. Virginia	.03	Rescue Eula	.13
Gould & Curry	.02	West End Con.	.82
Hale & Norcross	.03	Atlanta	.41
Julia	‡.01	Booth	.49
Mexican	.31	C.O.D. Con.	.05
Occidental	.79	Comb. Frac.	.13
Ophir	.05	Jumbo Extension	1.55
Overman	‡.10	Pitts.-Silver Peak	.12
Potosi	.01	Round Mountain	.41
Savage	.03	Sandstorm Kendall	.11
Sierra Nevada	.06	Silver Pick	.11
Union Con.	.20	Central Eureka	.19
Yellow Jacket	.19	So. Eureka	‡2.25

N. Y. EXCH. Apr. 26	
Name of Comp.	Clg.
Amalgamated	78½
Am.Sm.&Ref.,com	74½
Am. Sm. & Ref., pf.	106½
Am. Sm. Sec., pf. B.	82
Anaconda	38⅜
Batopilas Min.	1½
Bethlehem Steel	144½
Bethlehem Steel, pf.	111
Chino	48½
Colo. Fuel & Iron	31½
Federal M. & S., pf.	34
Great Nor., ore., ctf.	37½
Guggen. Exp.	64
Homestake	116
Inspiration Con.	34⅛
Mex. Petroleum	90½
Miami Copper	28⅛
Nat'l Lead, com.	64
National Lead, pf.	109½
Nev. Consol.	16½
Ontario Min	3
Quicksilver, pf.	1½
Ray Con.	24½
Republic I&S, com.	28½
Republic I&S, pf.	85½
SlossSheffi'd, com	37
Tennessee Copper	35
Utah Copper	71½
U. S. Steel, com.	57⅞
U. S. Steel, pf.	108½

N. Y. CURB Apr. 26	
Name of Comp.	Clg.
Alaska Juneau, w.i.	15½
Alta Con.	.87
Beaver Con.	.40
Big Four	.05
Blue Bell	.04
Braden Copper	8½
Buffalo Mines	.50
Can. Cop. Corpn.	1⅛
Can. G. & S.	.04
Caribou	‡.50
Cashboy	.09
Chambers Ferland	.23
Con. Ariz. Sm.	1
Con. Coppermines	2½
Davis-Daly	1½
Diam'field-Daisy	.08
Dia. Black B.	.03
Florence	.59
Goldfield Con.	1 9/16
Goldfield Merger	.30
Greene Cananea	35½
Kerr Lake	5
La Rose	9/16
McKinley-Dar-Sa.	.32
Mines of Am.	2½
Nevada Hills	.25
New Utah Bingham	1½
Nipissing Mines	6
Ohio Copper	.26
Oro	.11½
Pacific Smelt.	‡.09⅜
South Utah	⅜
Stand'd Oil of N.J.	404
Standard S. L.	1.68½
Stewart	1⅞
Tonopah	7⅛
Tonopah Ex.	3⅛
Tonopah Merger	.41
Tularosa	3/16
West End Ex.	.07
Yukon Gold	2⅛

LONDON Apr. 15			
Alaska Tre'dwell	£7	7s	6d
Camp Bird	0	6	3
El Oro	0	7	10½
Esperanza	0	9	0
Mexico Mines	3	16	3
Oroville	0	11	6
Philippine Dr.	1	0	0
Santa Gert'dis.	0	7	6
Tomboy	1	4	6
Tough Oakes	0	14	3

BOSTON EXCH Apr. 26	
Name of Comp.	Clg.
Adventure	4
Ahmeek	375
Alaska Gold M.	39
Algomah	3½
Allouez	57½
Am. Zinc	39⅛
Ariz. Com., ctfs.	8½
Bonanza	.65
Butte-Ballaklava	4
Butte & Superior	65½
Calumet & Ariz.	77
Calumet & Hecla	610
Centennial	24
Cliff	‡1
Copper Range	61½
Daly West	‡3
East Butte	14½
Franklin	12½
Granby	92½
Hancock	21
Hedley	‡26⅛
Helvetia	.90
Indiana	8⅛
Island Cr'k, com.	‡46½
Island Cr'k, pfd.	90½
Isle Royale	32½
Keweenaw	4⅛
Lake	16½
La Salle	8½
Mass.	14½
Mayflower	7½
Michigan	2½
Mohawk	81
New Arcadian	12½
North Butte	37½
North Lake	3½
Ojibway	3
Old Colony	6½
Old Dominion	57½
Osceola	90
Quincy	92
Santa Fe	‡1½
Shannon	11
Shattuck-Ariz.	32
Superior	39½
Superior & Bost.	3⅛
Tamarack	44
Trinity	6
Tuolumne	.58
U. S. Smelting	37½
U. S. Smelt'g, pf.	46
Utah Apex	3½
Utah Con.	14
Victoria	3½
Winona	4½
Wolverine	68½
Wyandot	2 3/16

BOSTON CURB Apr. 26	
Name of Comp.	Bid.
Alvarado	.60
Bingham Mines	6⅜
Boston Ely	.40
Butte & Lon'n Dev.	.26
Calaveras	2
Calumet-Corbin	.13
Chief Con.	.95
Corbin	.90
Cortez	.30
Crown Reserve	.90
Eagle & Blue Bell	1 7/16
First Nat. Cop.	2½
Houghton Copper	4½
Iron Cap Cop., pf.	5½
Majestic	.35
Mexican Metals	.20
Nevada-Douglas	.90
New Baltic	4½
Oneco	2⅜
Raven Copper	‡.07
Smokey Dev.	.25
So. Lake	8½
Tonopah Victor	‡.17
Trethewey	.12
United Verde Ext.	3⅜

‡Last Quotations.

Monthly Average Prices of Metals

SILVER

Month	New York			London		
	1913	1914	1915	1913	1914	1915
January	62.938	57.572	48.855	28.983	26.553	22.731
February	61.642	57.506	48.477	28.357	26.573	22.753
March	57.870	58.067	50.241	26.669	26.788	23.708
April	59.490	58.519	.....	27.416	26.958	.....
May	60.361	58.175	.....	27.825	26.704	.....
June	58.990	56.471	.....	27.199	25.948	.....
July	58.721	54.678	.....	27.074	25.219	.....
August	59.293	54.344	.....	27.335	25.979	.....
September	60.640	53.290	.....	27.986	24.260	.....
October	60.793	50.654	.....	28.083	23.199	.....
November	58.995	49.082	.....	27.263	22.703	.....
December	57.760	49.375	.....	26.720	22.900	.....
Year	59.791	54.811	.....	27.576	25.314	.....

New York quotations cents per ounce troy, fine silver: London, pence per ounce, sterling silver, 0.925 fine.

COPPER

Month	New York Electrolytic		London Standard		London Best Selected	
	1914	1915	1914	1915	1914	1915
January	14.223	13.641	64.304	60.756	69.488	65.719
February	14.491	14.394	65.259	63.494	70.188	*
March	14.131	14.787	64.276	66.152	69.170	*
April	14.211	.....	64.747	.....	69.313	.....
May	13.996	.....	63.182	.....	67.786	.....
June	13.603	.....	61.336	.....	66.274	.....
July	13.223	.....	60.540	.....	64.955	.....
August	*	.....	‡	.....	‡	.....
September	*	.....	‡	.....	‡	.....
October	*	.....	‡	.....	‡	.....
November	11.739	.....	53.227	.....	*	.....
December	12.801	.....	56.841	.....	*	.....
Year	.....	.....	.....	.....	.....	.....

TIN

Month	New York		London	
	1914	1915	1914	1915
January	37.779	34.260	171.905	156.550
February	39.830	37.415	181.556	176.925
March	38.038	48.426	173.619	180.141
April	36.154	.....	163.963	.....
May	33.360	.....	150.702	.....
June	30.577	.....	138.321	.....
July	31.707	.....	142.517	.....
August	*	.....	‡	.....
September	32.675	.....	‡	.....
October	30.284	.....	‡	.....
November	33.304	.....	139.391	.....
December	33.601	.....	147.102	.....
Av. year	34.301	.....	.....	.....

LEAD

Month	New York		St. Louis		London	
	1914	1915	1914	1915	1914	1915
January	4.111	3.729	4.011	3.548	19.665	18.606
February	4.048	3.827	3.937	3.718	19.606	19.122
March	3.970	4.053	3.850	3.997	19.651	21.883
April	3.810	.....	3.688	.....	18.225	.....
May	3.900	.....	3.808	.....	18.503	.....
June	3.900	.....	3.810	.....	19.411	.....
July	3.891	.....	3.738	.....	19.051	.....
August	3.875	.....	3.715	.....	‡	.....
September	3.828	.....	3.658	.....	‡	.....
October	3.528	.....	3.384	.....	‡	.....
November	3.683	.....	3.585	.....	18.500	.....
December	3.800	.....	3.662	.....	19.097	.....
Year	3.862	.....	3.737	.....	.....	.....

SPELTER

Month	New York		St. Louis		London	
	1914	1915	1914	1915	1914	1915
January	5.262	6.386	5.112	6.211	21.533	30.844
February	5.377	8.436	5.228	8.255	21.413	39.819
March	5.250	8.541	5.100	8.366	21.460	44.141
April	5.113	.....	4.963	.....	21.569	.....
May	5.074	.....	4.924	.....	21.393	.....
June	5.000	.....	4.850	.....	21.345	.....
July	4.920	.....	4.770	.....	21.568	.....
August	5.568	.....	5.418	.....	‡	.....
September	5.380	.....	5.230	.....	‡	.....
October	4.909	.....	4.750	.....	‡	.....
November	5.112	.....	4.962	.....	25.016	.....
December	5.592	.....	5.430	.....	27.369	.....
Year	5.213	.....	5.061	.....	.....	.....

New York and St. Louis quotations, cents per pound. London, pounds sterling per long ton. * Not reported, ‡ London Exchange closed.

PIG IRON IN PITTSBURGH

Month	Bessemer		Basic		No. 2 Foundry	
	1914	1915	1914	1915	1914	1915
January	$14.94	$14.59	$13.23	$13.45	$13.99	$13.90
February	15.06	14.55	14.12	13.45	14.08	13.90
March	15.07	14.55	13.94	13.45	14.10	13.95
April	14.90	.....	13.90	.....	14.13	.....
May	14.90	.....	13.90	.....	14.27	.....
June	14.90	.....	13.90	.....	13.96	.....
July	14.90	.....	13.90	.....	13.90	.....
August	14.90	.....	13.90	.....	14.08	.....
September	14.90	.....	13.90	.....	14.03	.....
October	14.84	.....	13.75	.....	13.97	.....
November	14.59	.....	13.43	.....	13.83	.....
December	14.70	.....	13.45	.....	13.83	.....
Year	$14.88	.....	$13.78	.....	$14.01	.....

The Mining Index

This index is a convenient reference to the current literature of mining and metallurgy published in all of the important periodicals of the world. We will furnish a copy of any article (if in print) in the original language for the price quoted. Where no price is quoted, the cost is unknown. Inasmuch as the papers must be ordered from the publishers, there will be some delay for foreign papers. Remittance must be sent with order. Coupons are furnished at the following prices: 20c. each, six for $1, 33 for $5, and 100 for $15. When remittances are made in even dollars, we will return the excess over an order in coupons, if so requested.

COPPER

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